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(12) **United States Patent**
Marotz et al.

(10) **Patent No.: US 9,062,441 B2**
(45) **Date of Patent: Jun. 23, 2015**

(54) **CABLE OVERLOAD DEVICE**

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(73) Assignee: **KOHLER CO.**, Kohler, WI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 277 days.

(21) Appl. No.: **13/588,470**

(22) Filed: **Aug. 17, 2012**

(65) **Prior Publication Data**

US 2013/0042405 A1 Feb. 21, 2013

Related U.S. Application Data

(60) Provisional application No. 61/525,049, filed on Aug. 18, 2011.

(51) **Int. Cl.**

E03C 1/12	(2006.01)
E03C 1/23	(2006.01)
E03C 1/232	(2006.01)
F16C 1/16	(2006.01)
F16C 1/22	(2006.01)
E03C 1/24	(2006.01)

(52) **U.S. Cl.**

CPC ***E03C 1/2304*** (2013.01); ***E03C 1/232*** (2013.01); *E03C 1/24* (2013.01); ***F16C 1/16*** (2013.01); ***F16C 1/223*** (2013.01); *E03C 2201/50* (2013.01)

(58) **Field of Classification Search**

CPC F16C 1/16; F16C 1/223
USPC 4/679, 680, 682–685, 688–690, 693, 4/287

See application file for complete search history.

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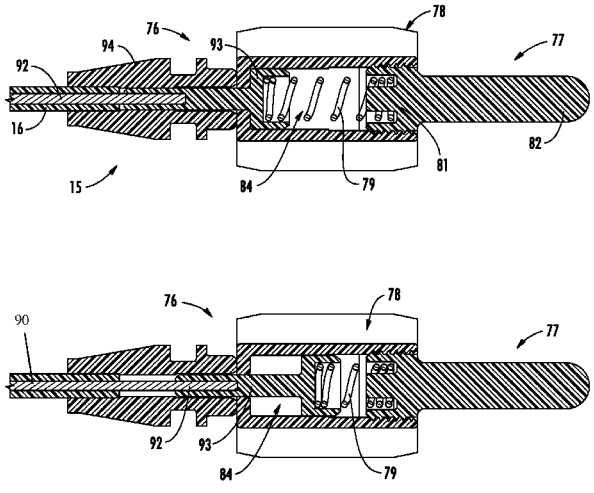
(57) **ABSTRACT**

A cable overload device for a cable-actuated drain system having a drain valve assembly and a drain control assembly where the cable includes a driving end connected to the control assembly and a driven end. The overload device includes a plunger, a linking member, a sleeve, and an energy absorber. The plunger is configured to be coupled to the driven end of the cable. The linking member is configured to move the drain valve assembly between open and closed positions. The sleeve includes a bore that extends from a first side to a second side of the sleeve, wherein the bore is configured to receive the plunger through the first side and to receive the linking member through the second side. The energy absorber is provided in the bore between the plunger and the linking member to absorb a force imposed into the linking member from the drain valve assembly.

26 Claims, 23 Drawing Sheets



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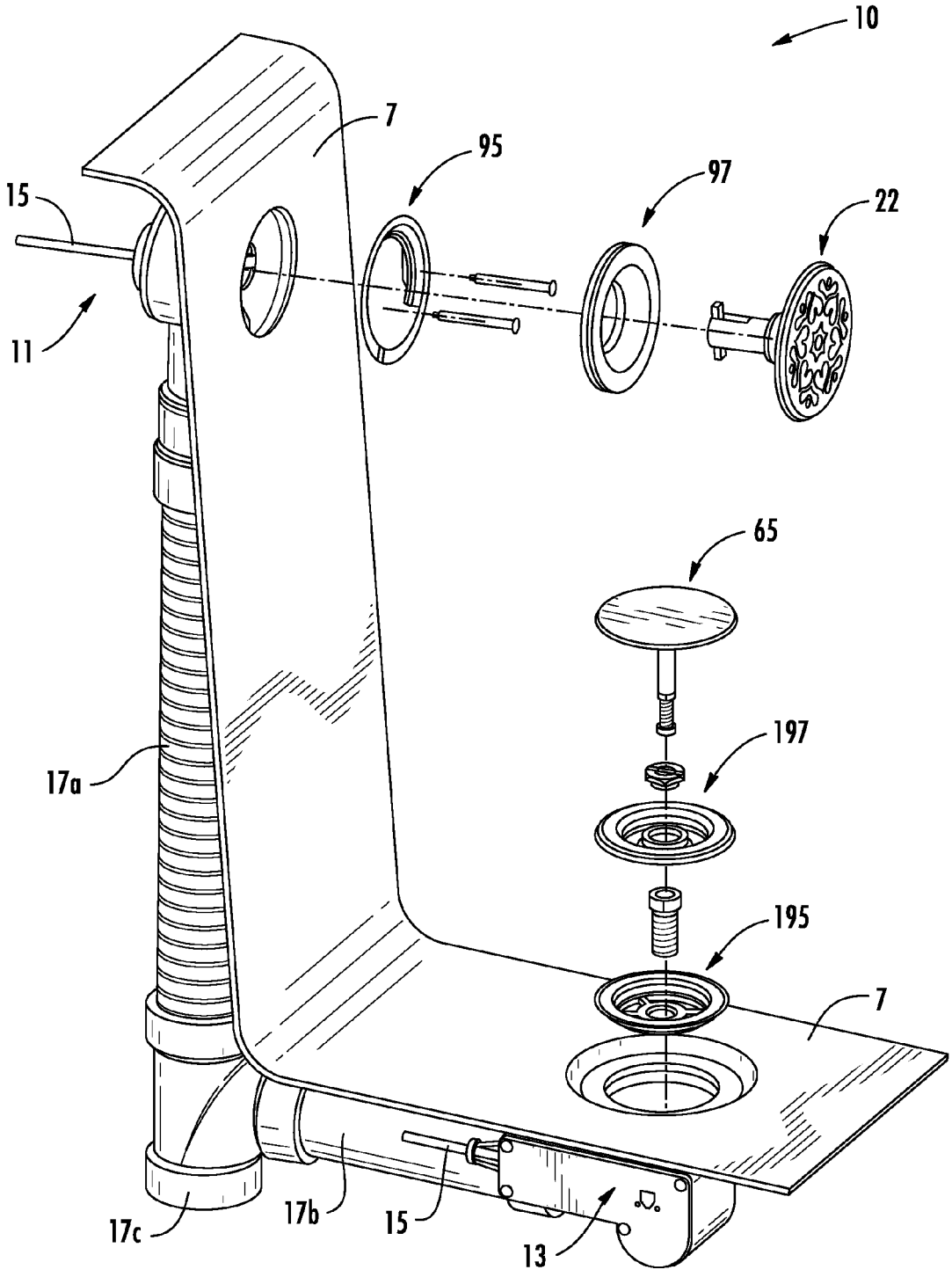

FIG. 1

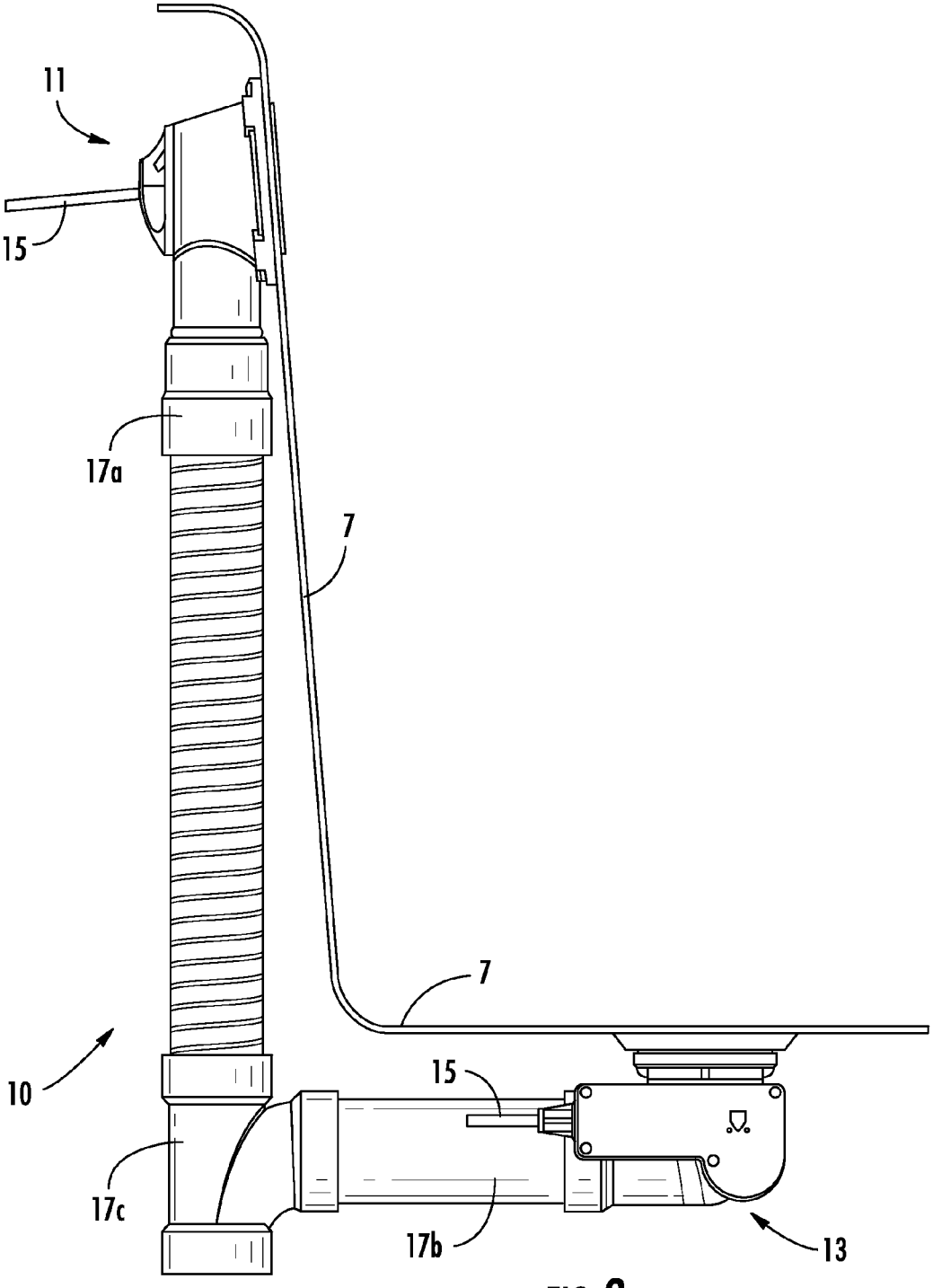

FIG. 2

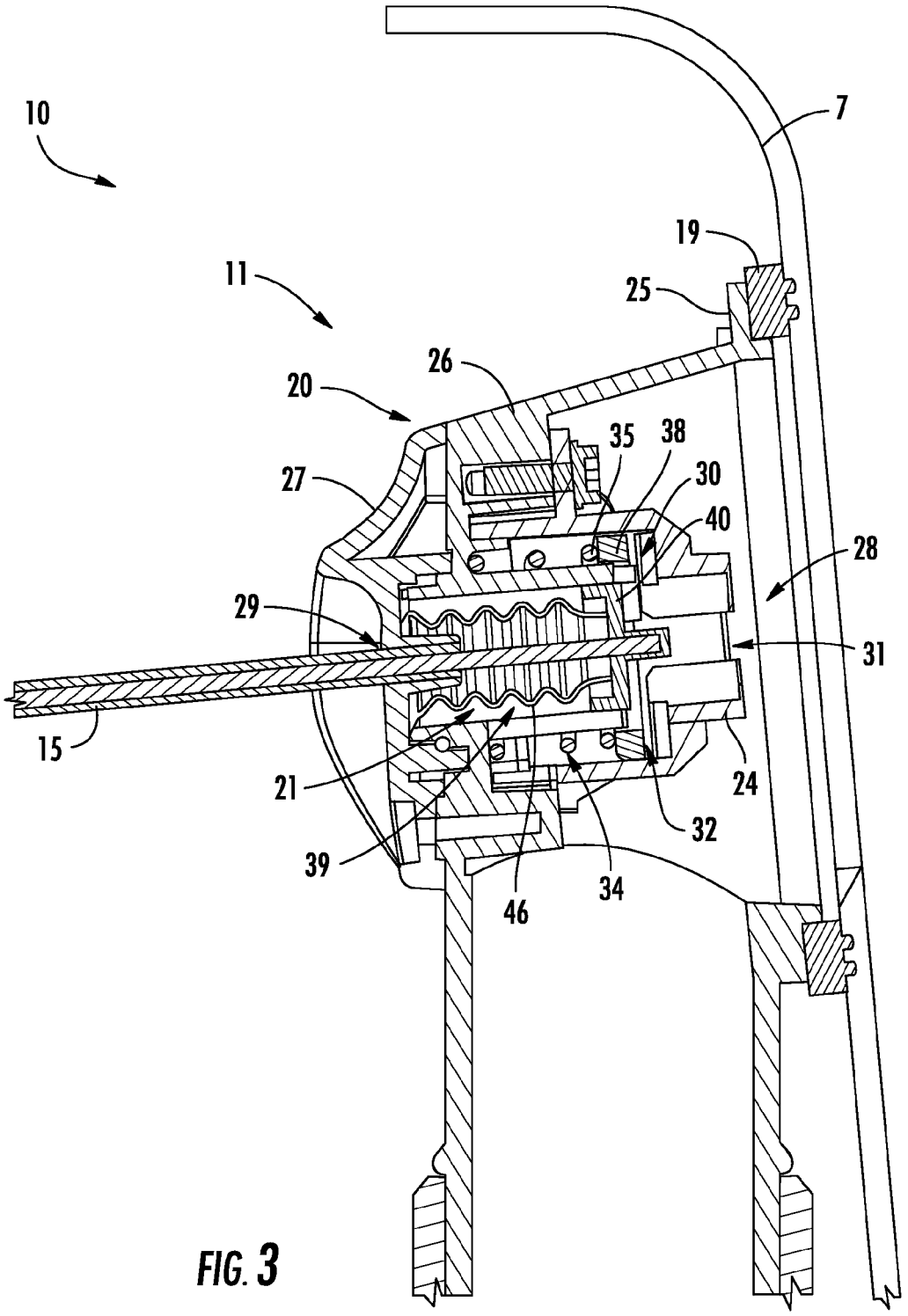

FIG. 3

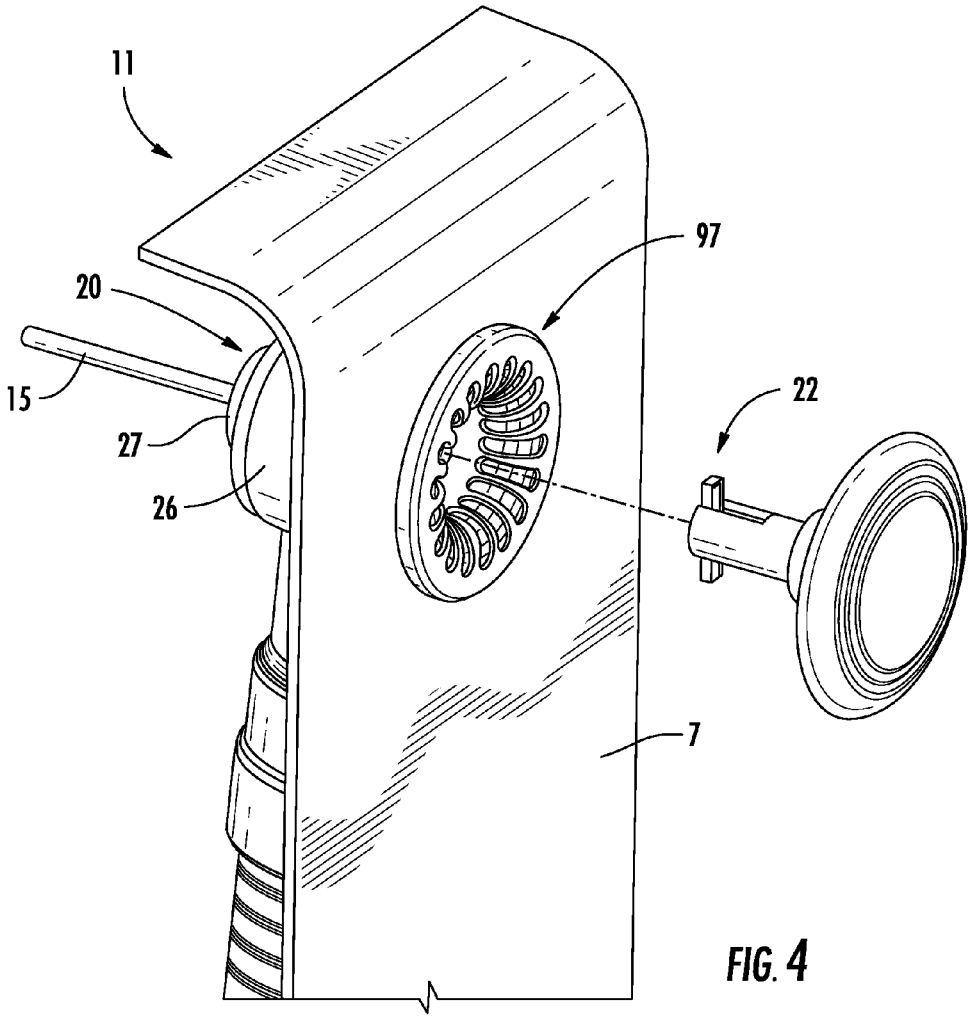

FIG. 4

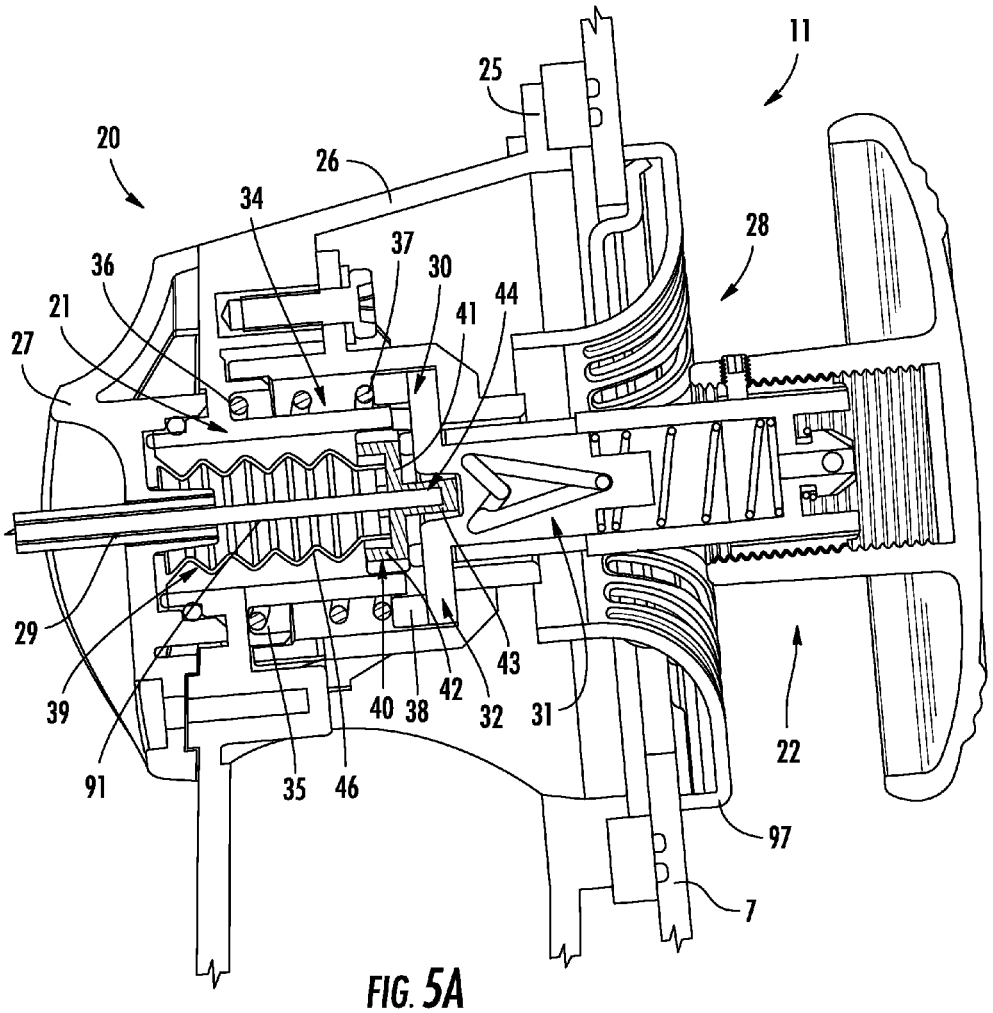
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FIG. 5A

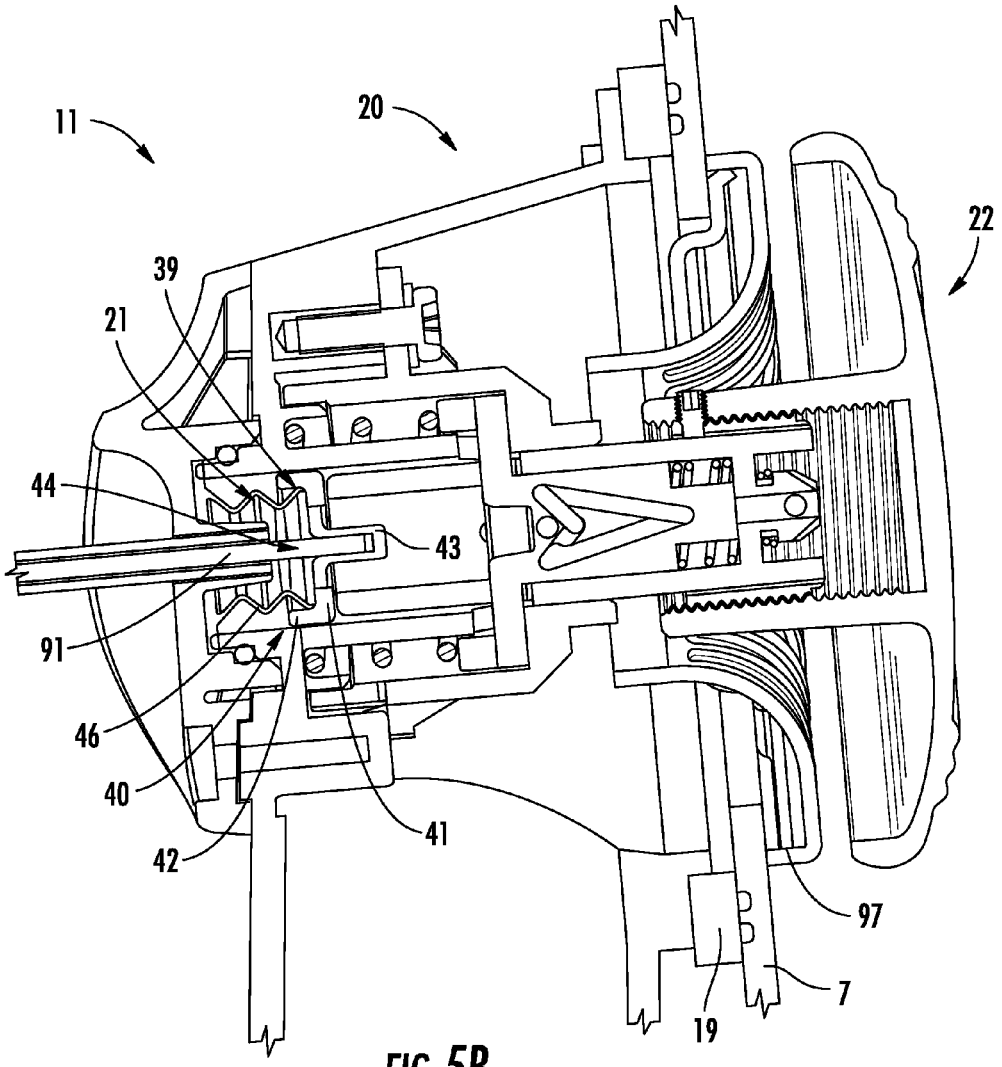

FIG. 5B

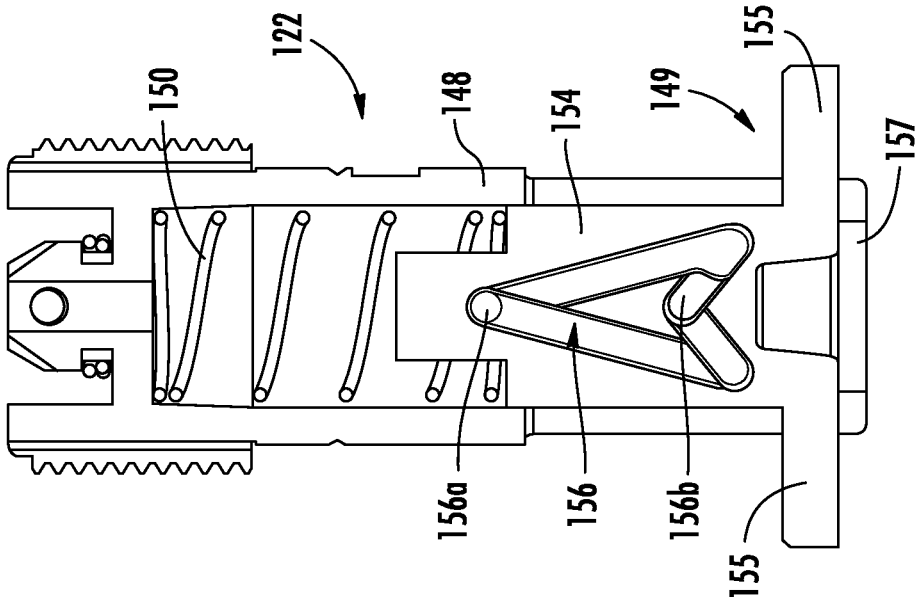
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FIG. 6A

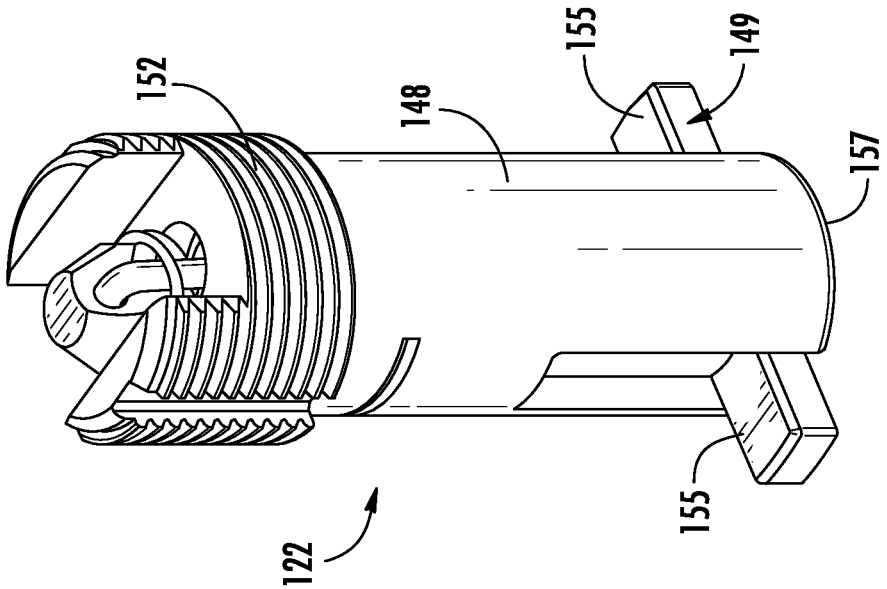
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FIG. 6

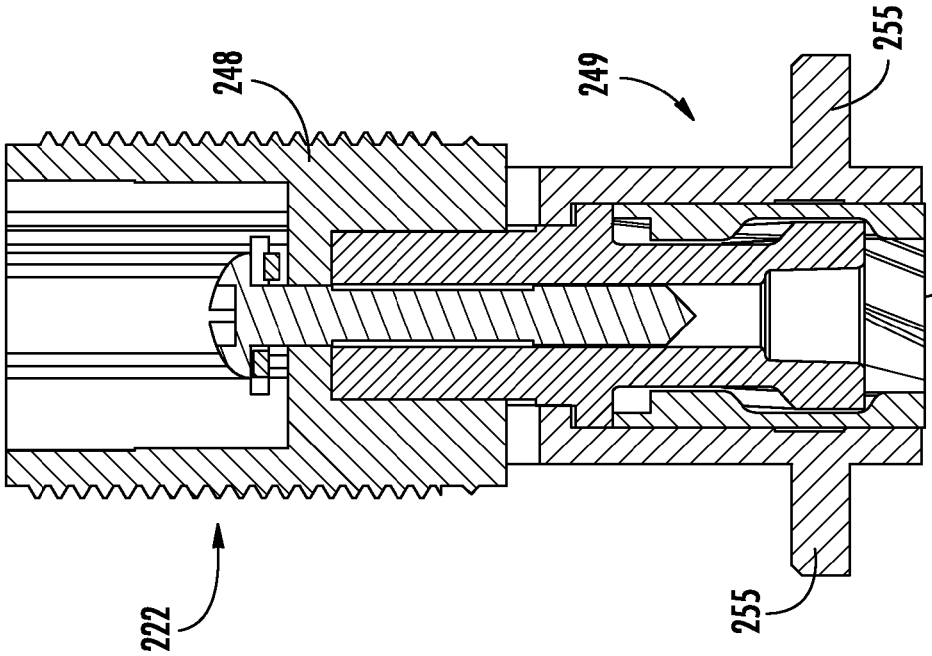


FIG. 7A

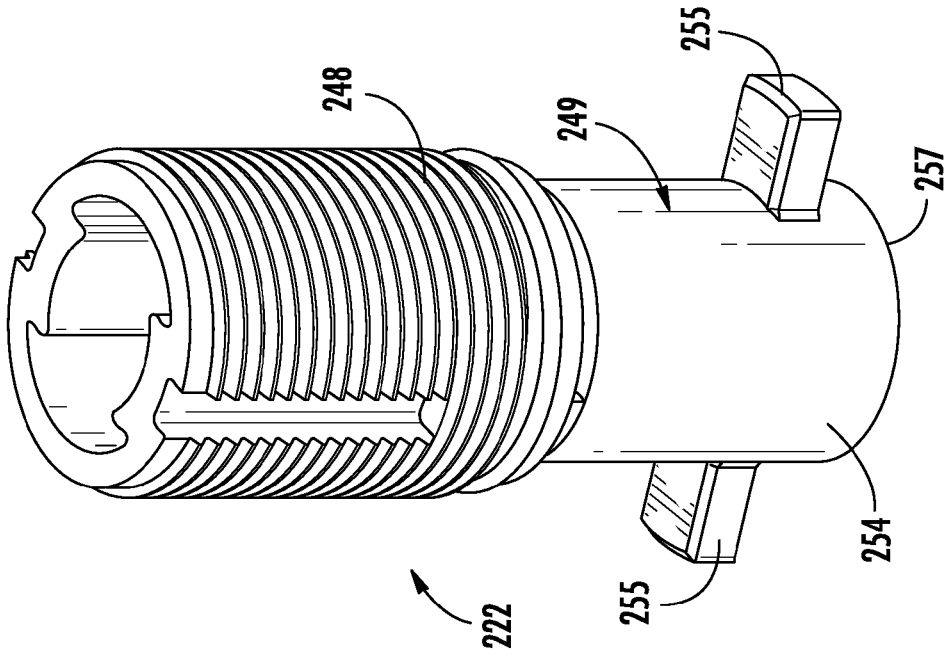


FIG. 7

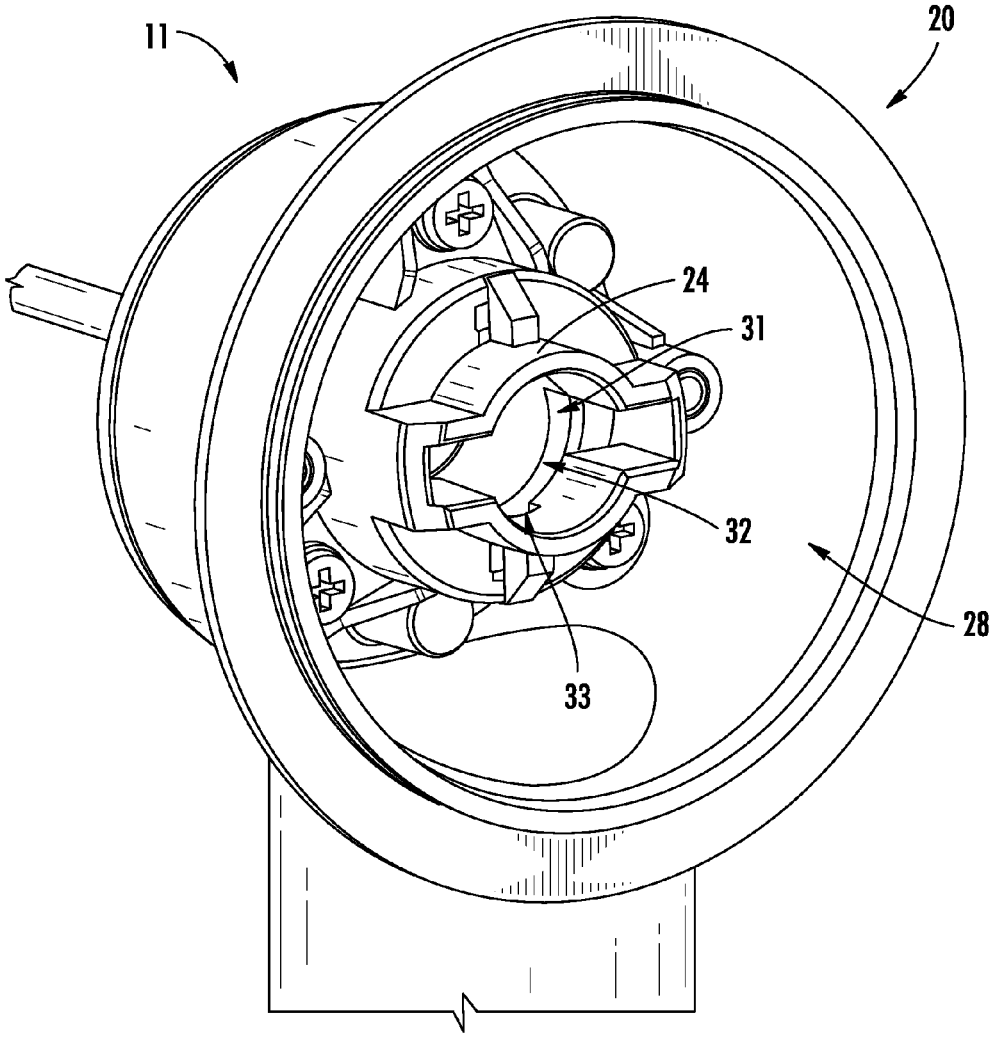


FIG. 8

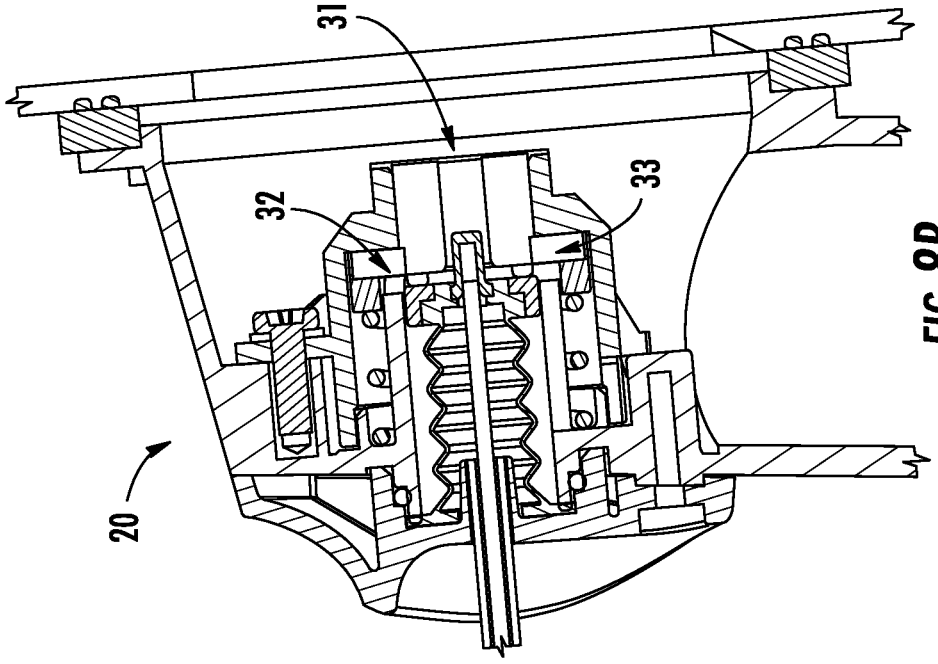


FIG. 8B

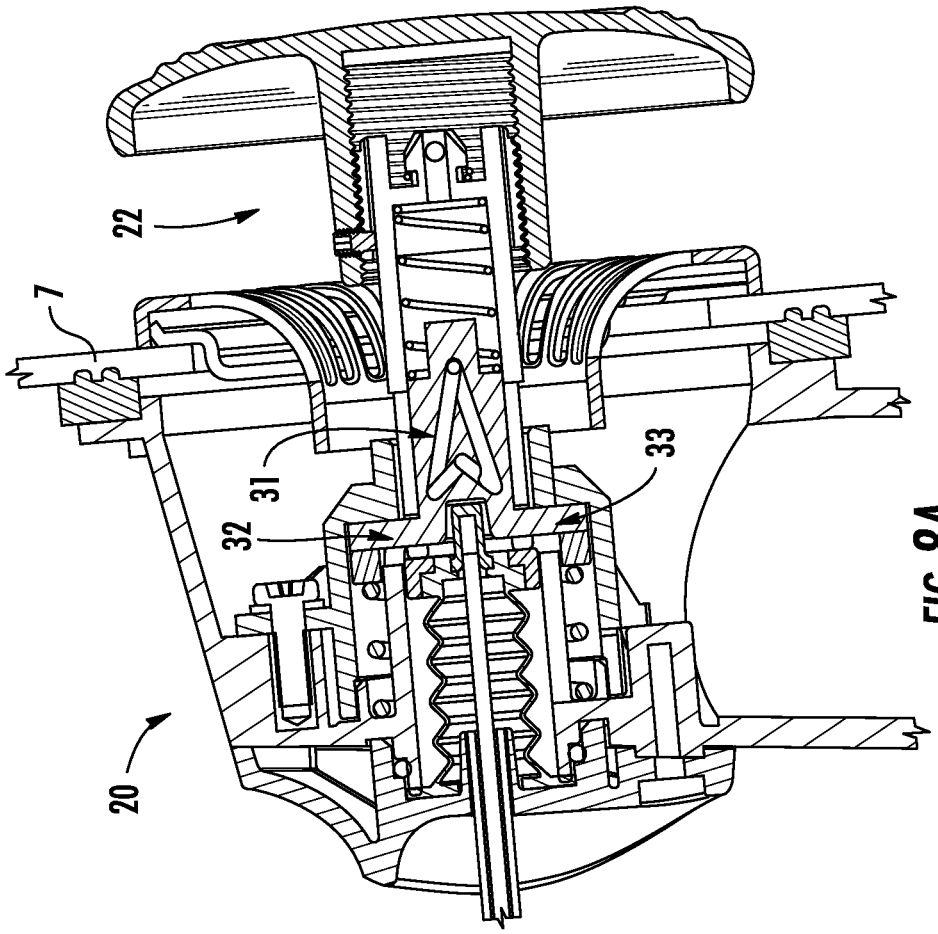


FIG. 8A

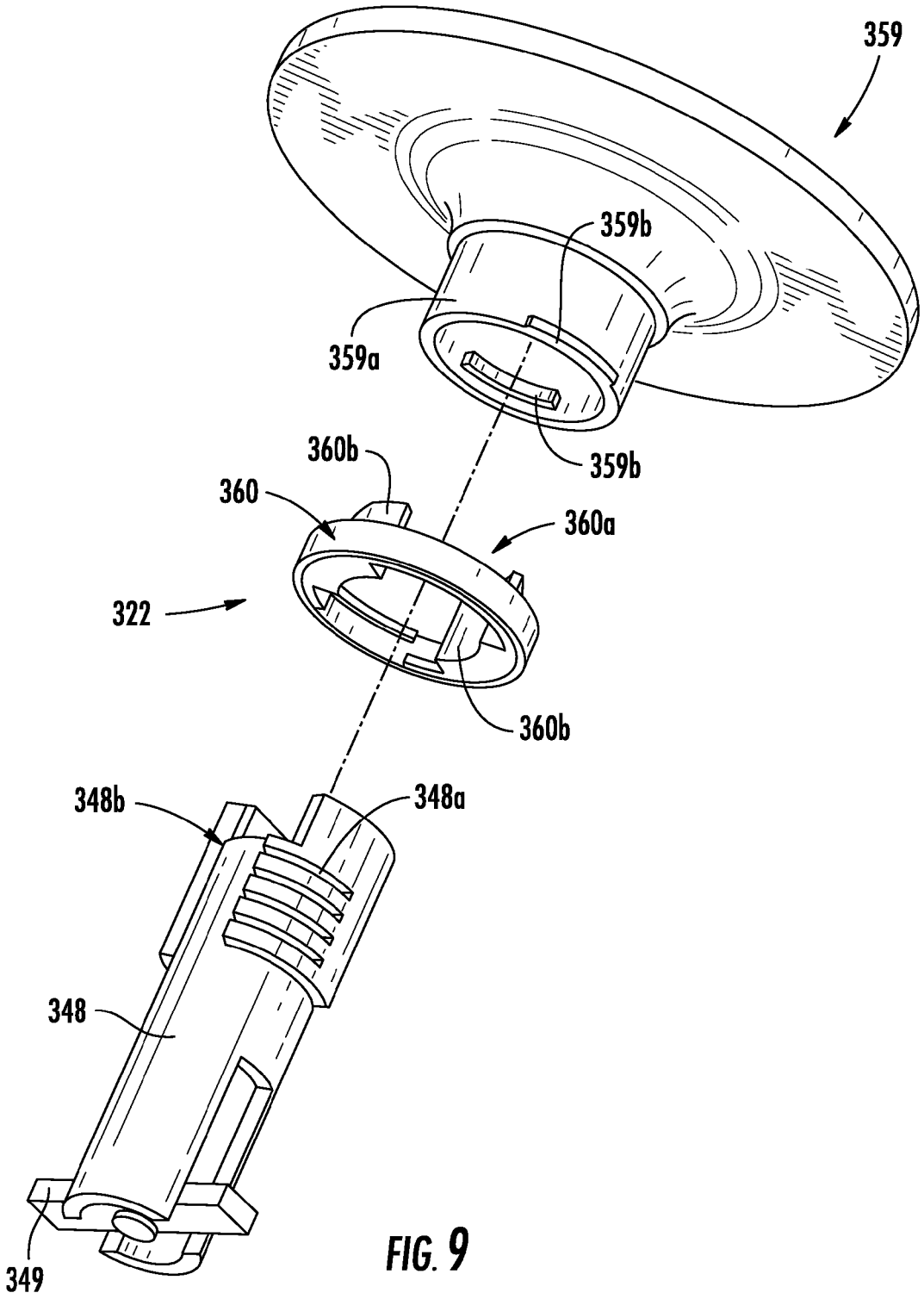
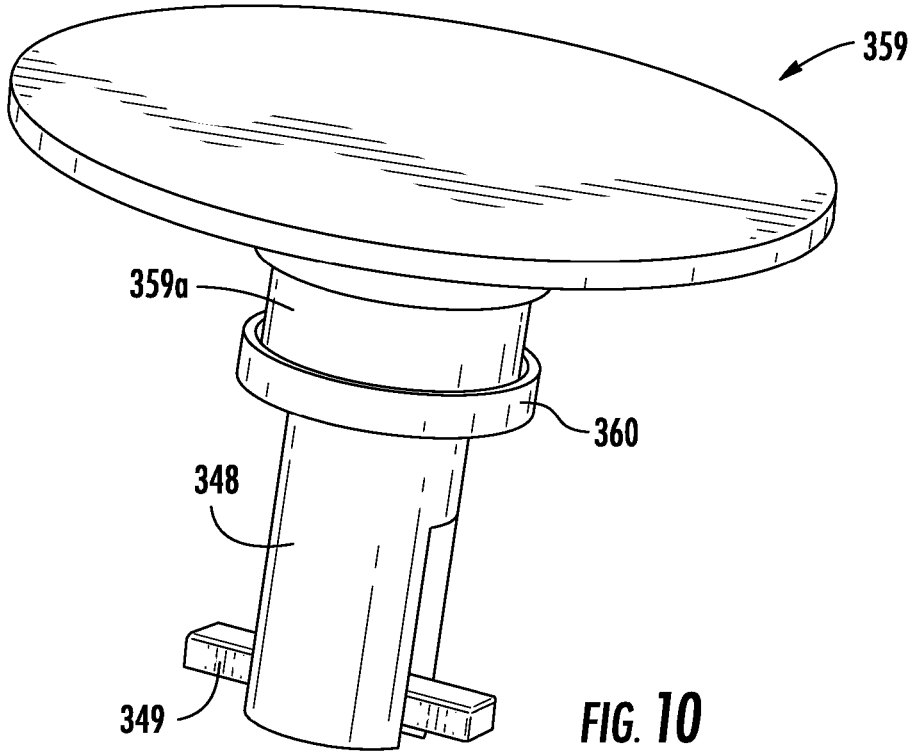


FIG. 9



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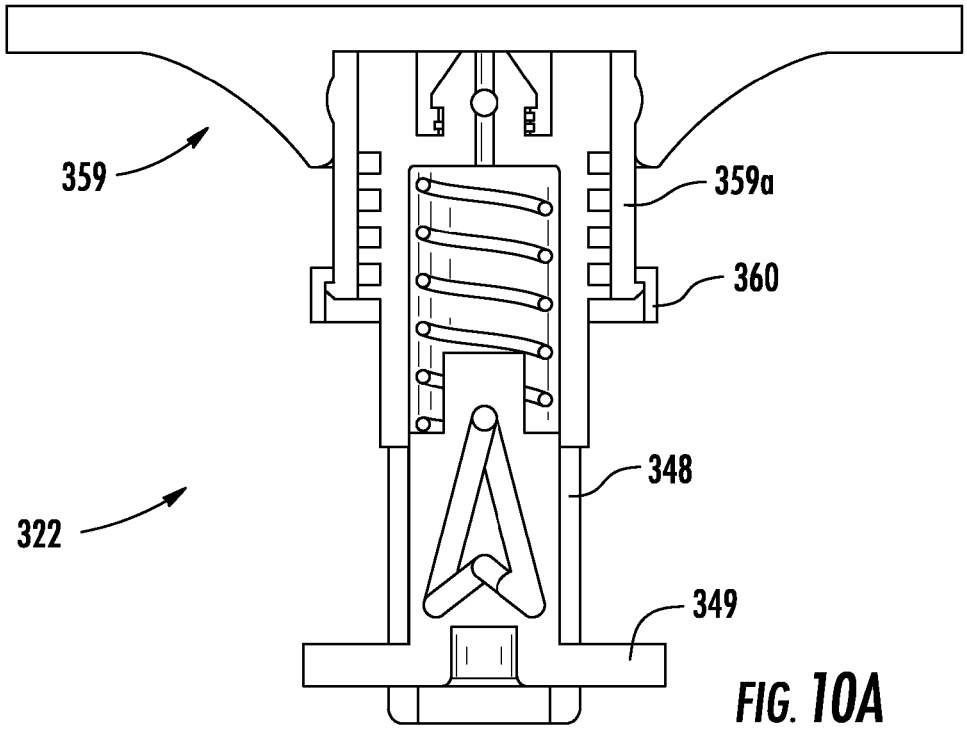


FIG. 10A

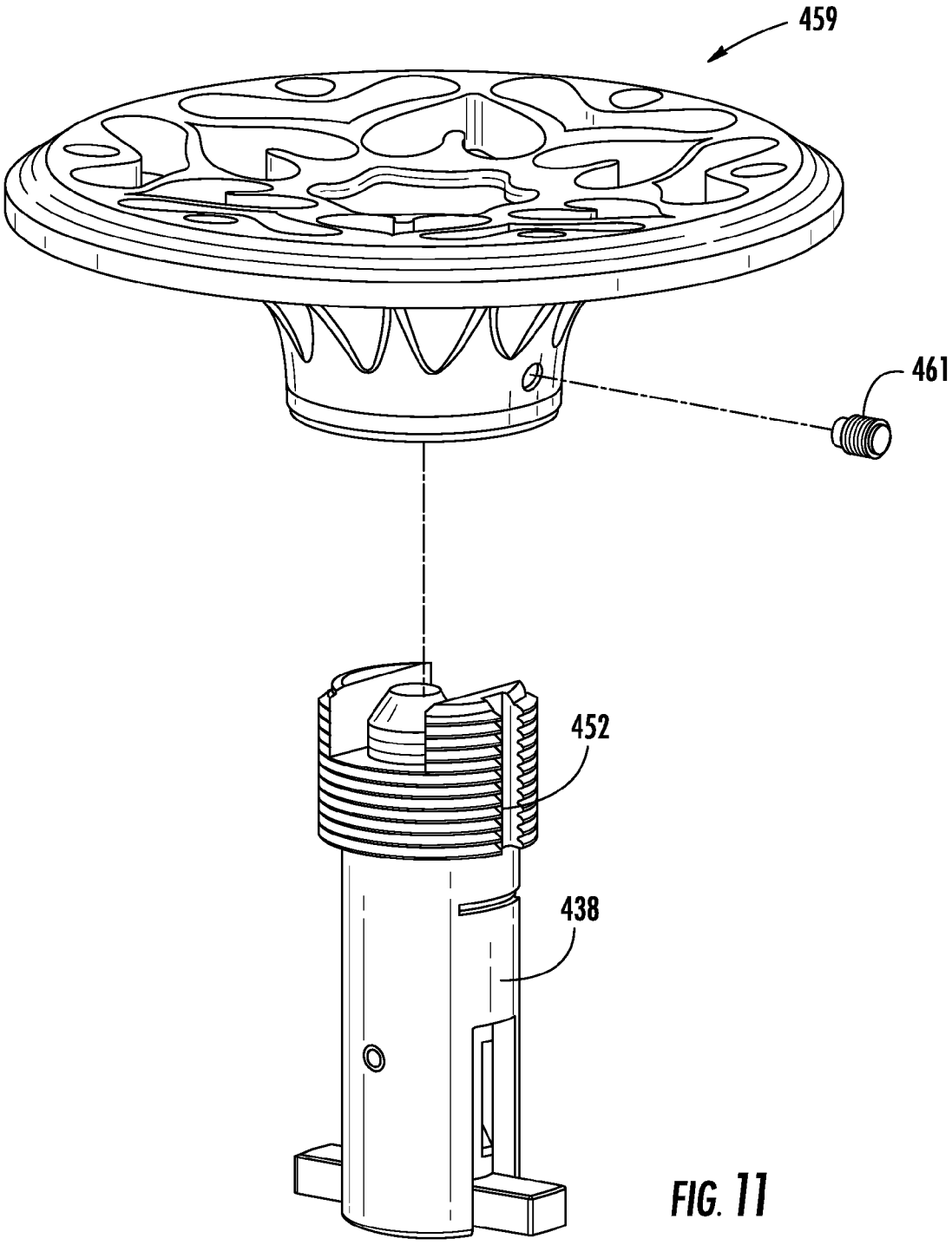


FIG. 11

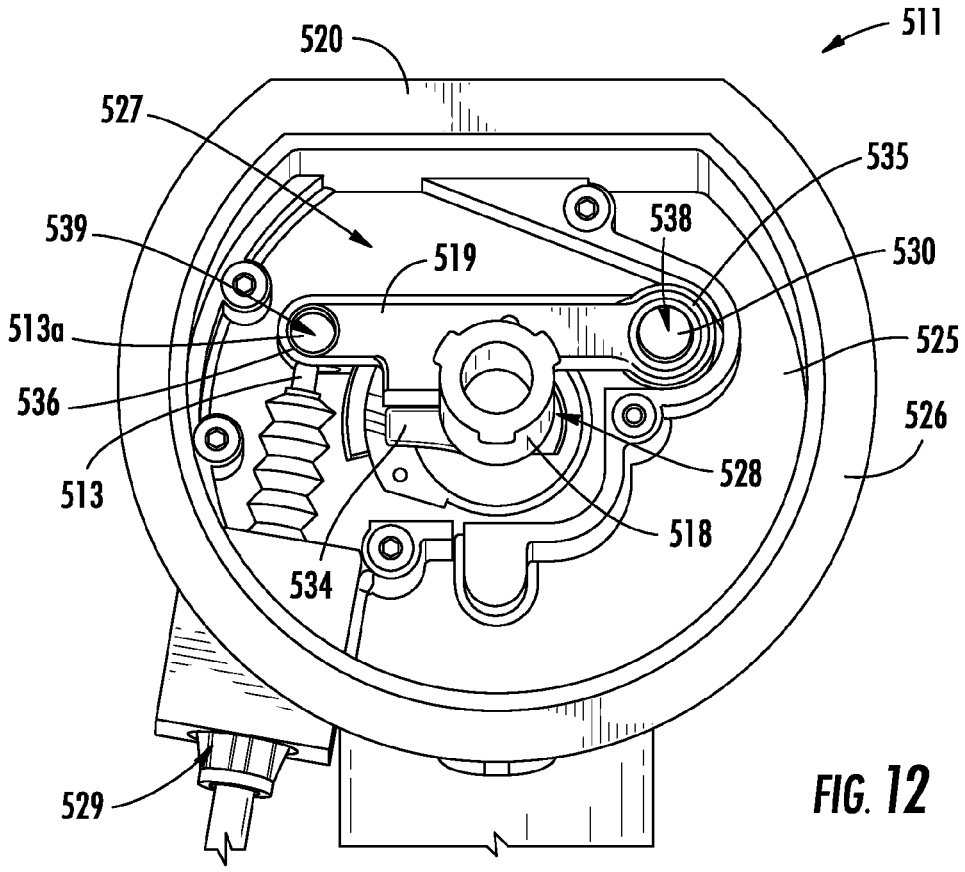


FIG. 12

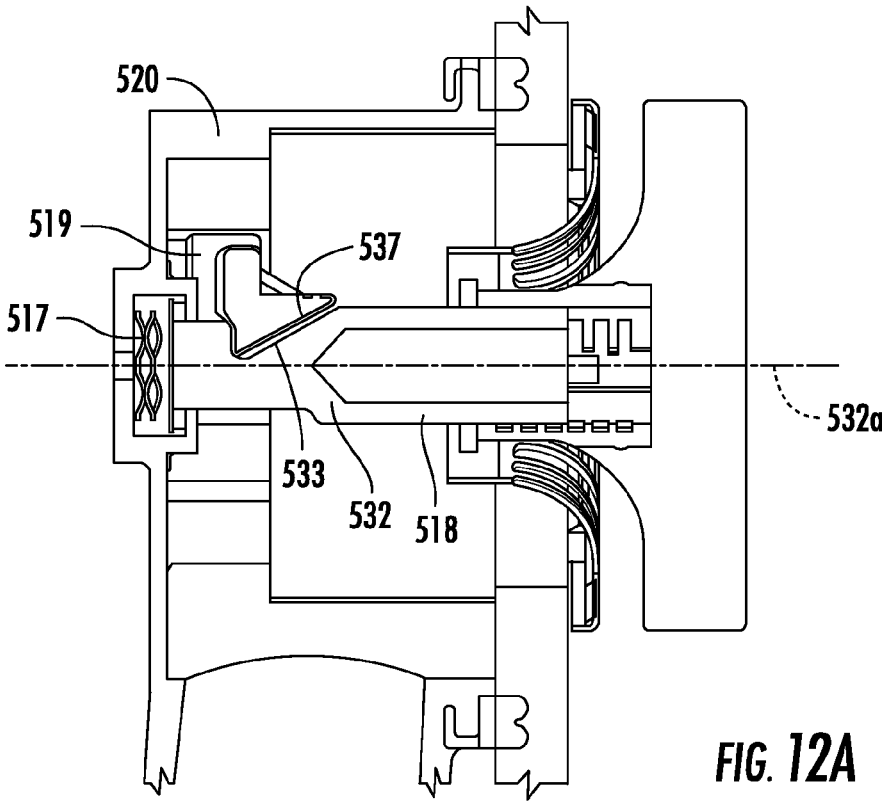


FIG. 12A

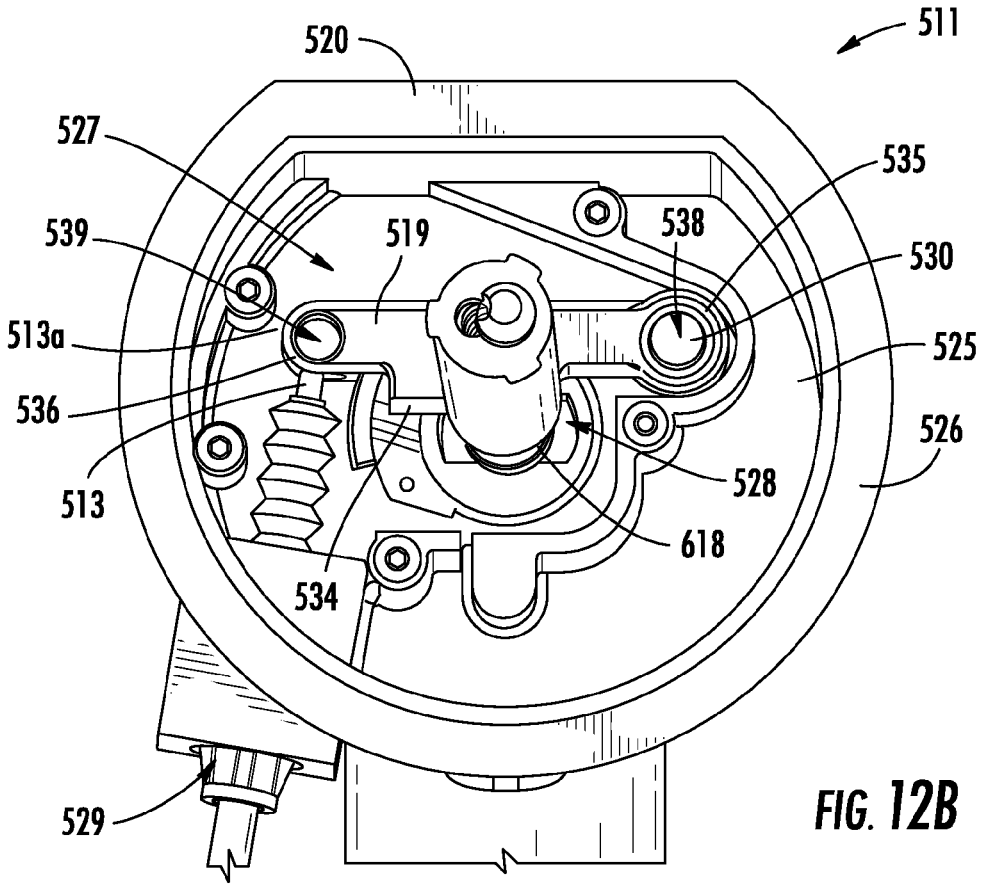


FIG. 12B

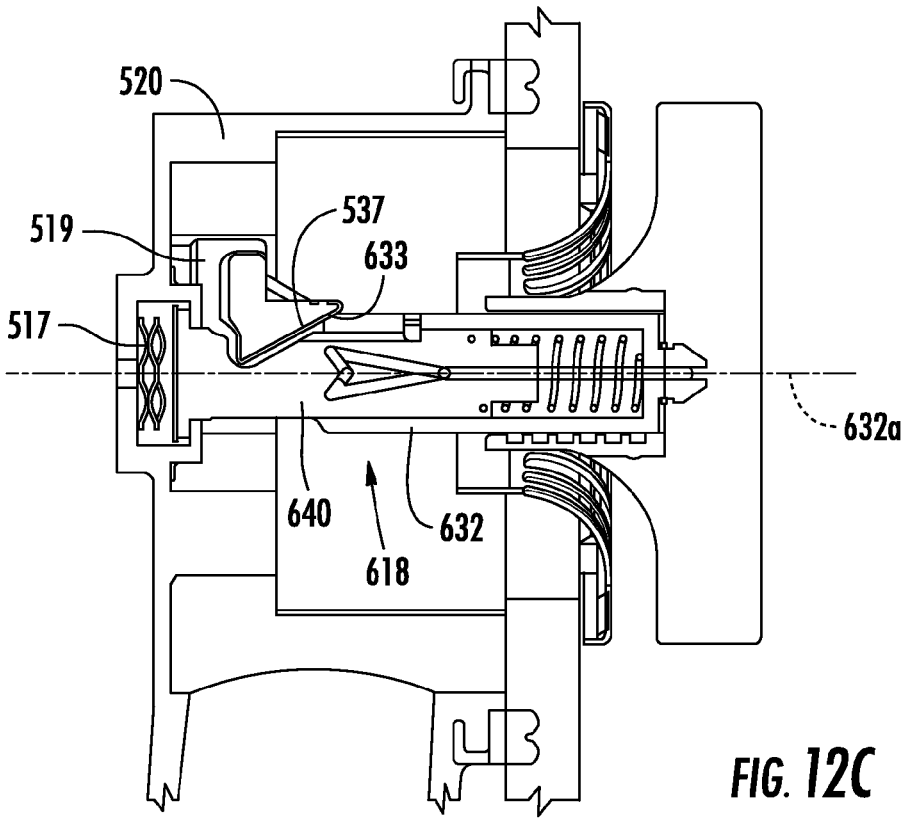


FIG. 12C

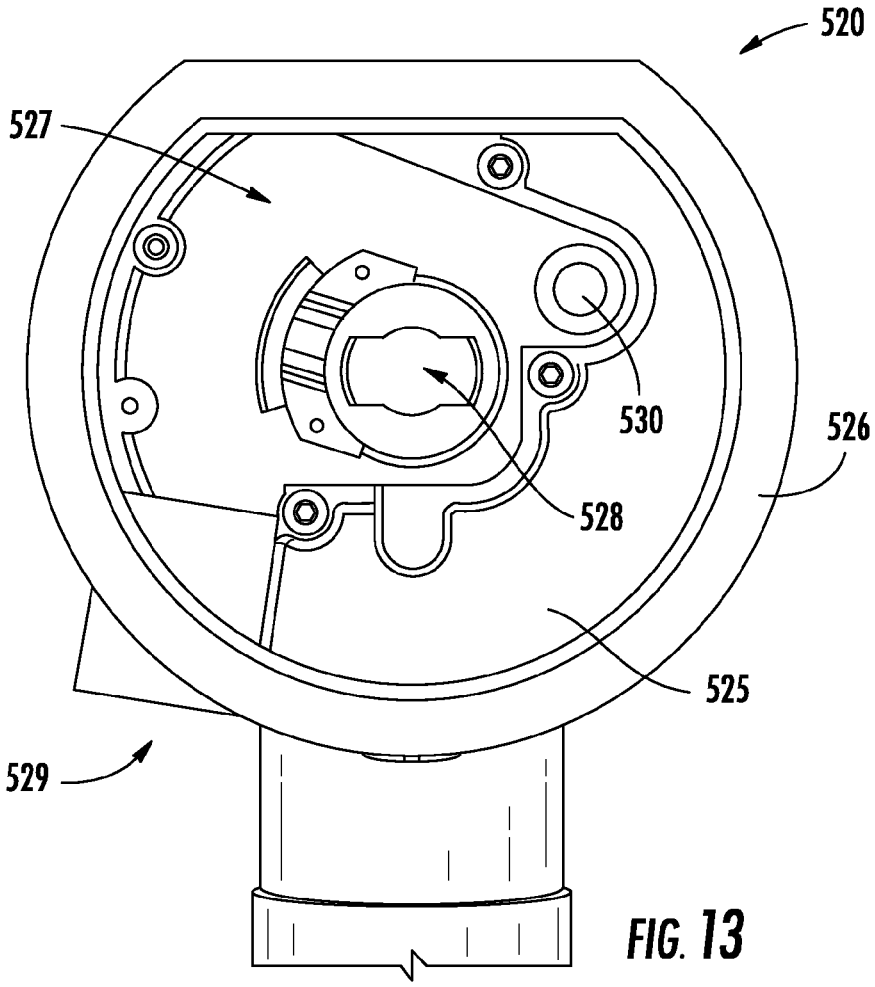


FIG. 13

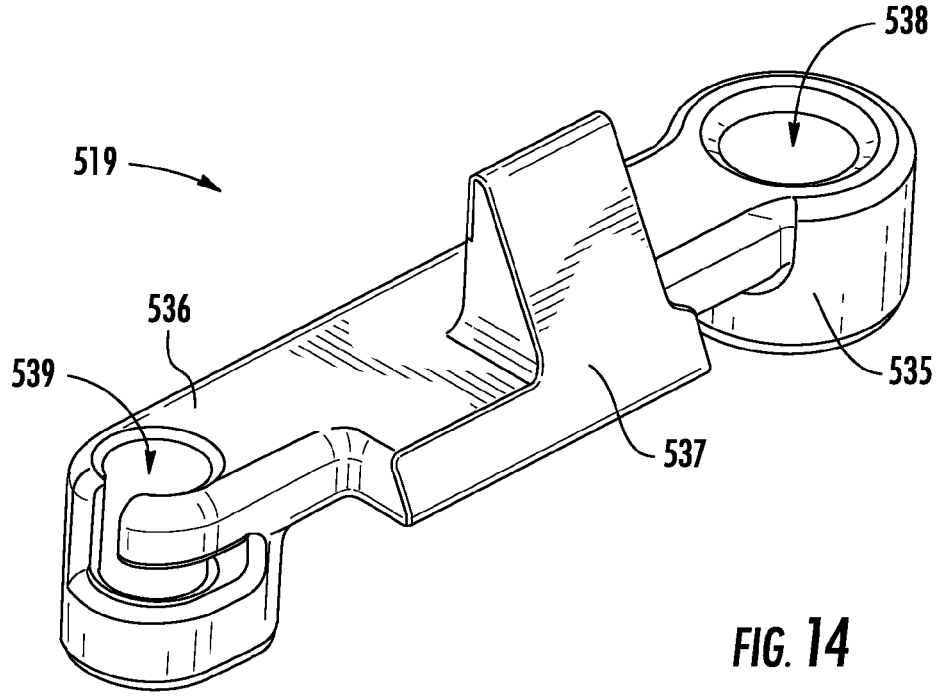
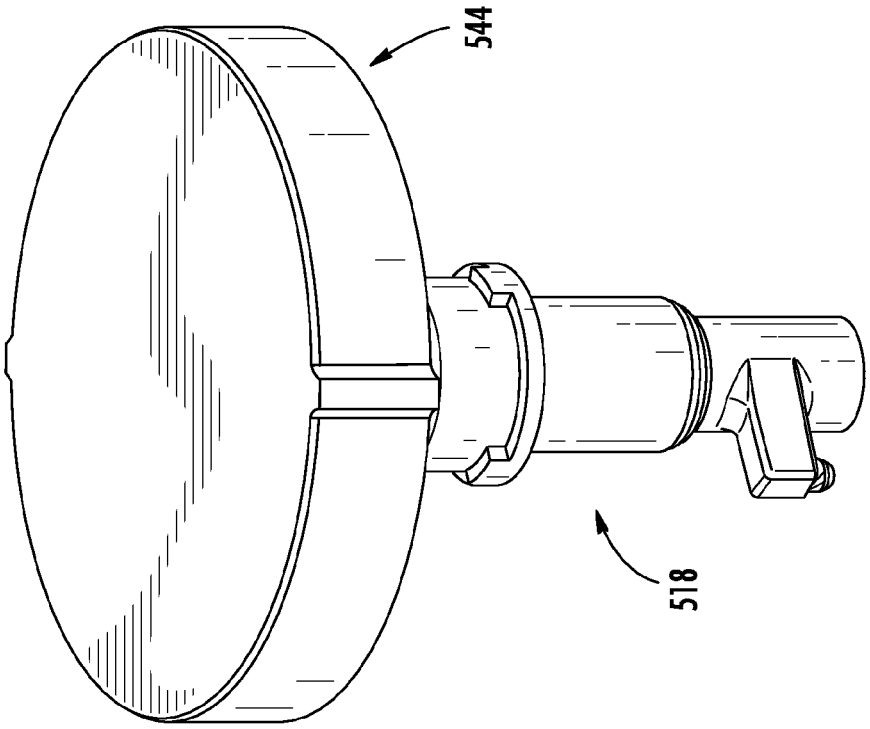


FIG. 14



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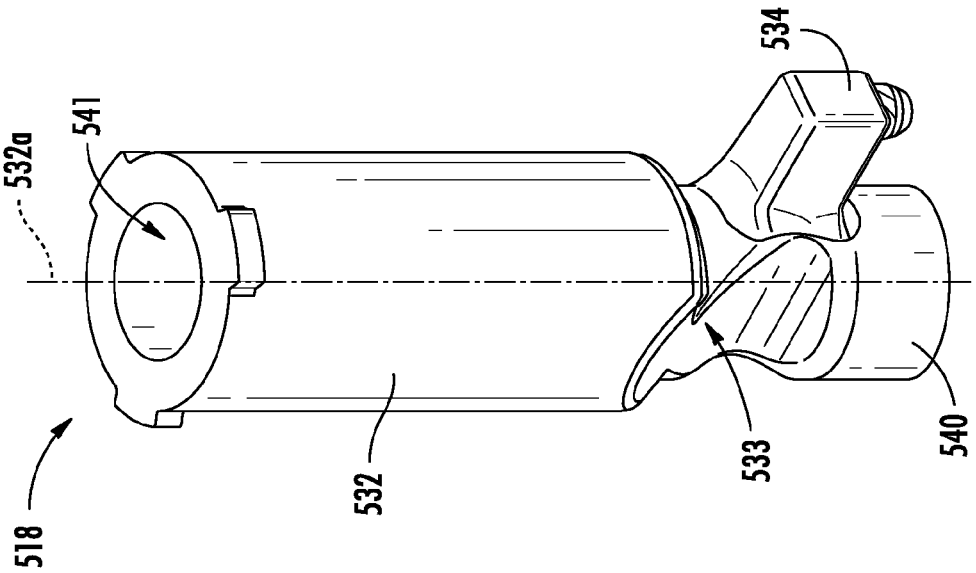


FIG. 15A

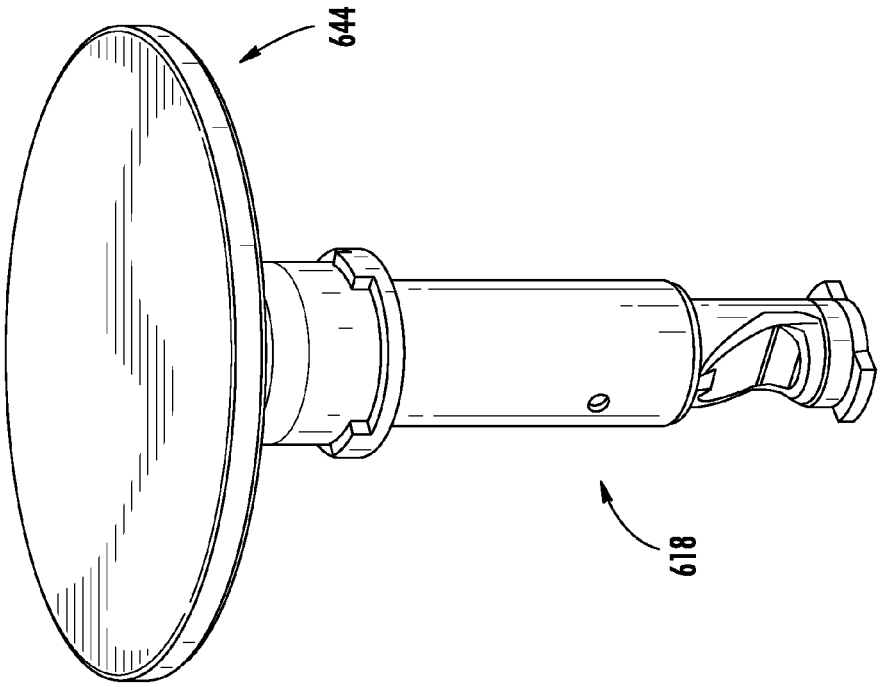


FIG. 15D

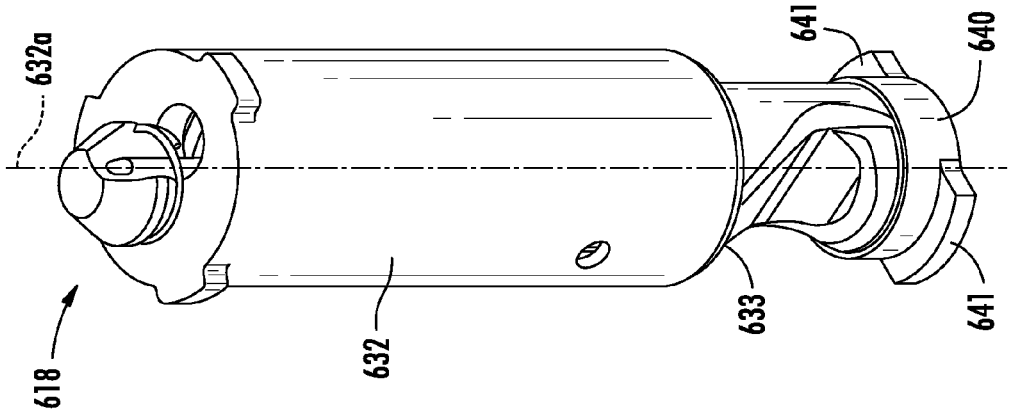


FIG. 15C

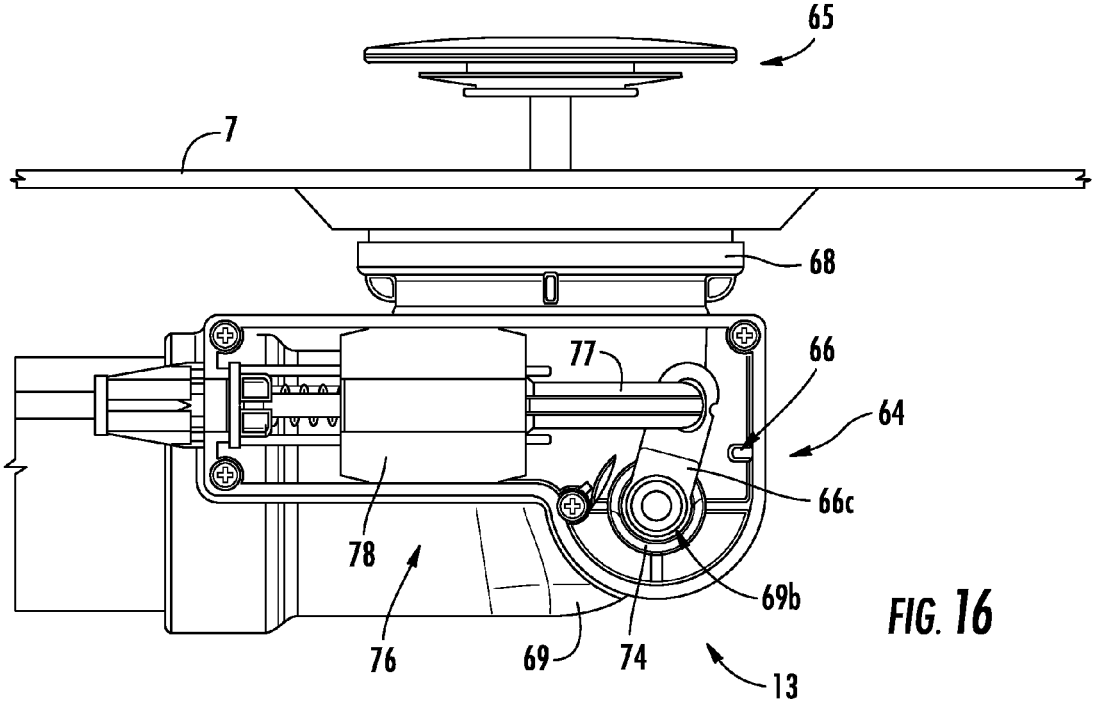


FIG. 16

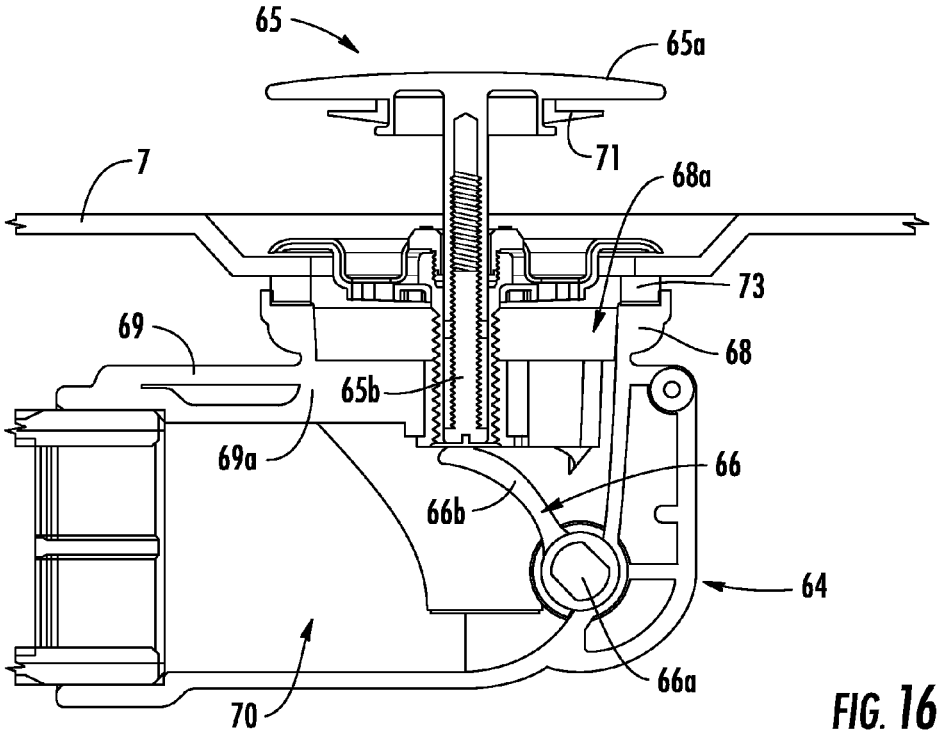


FIG. 16A

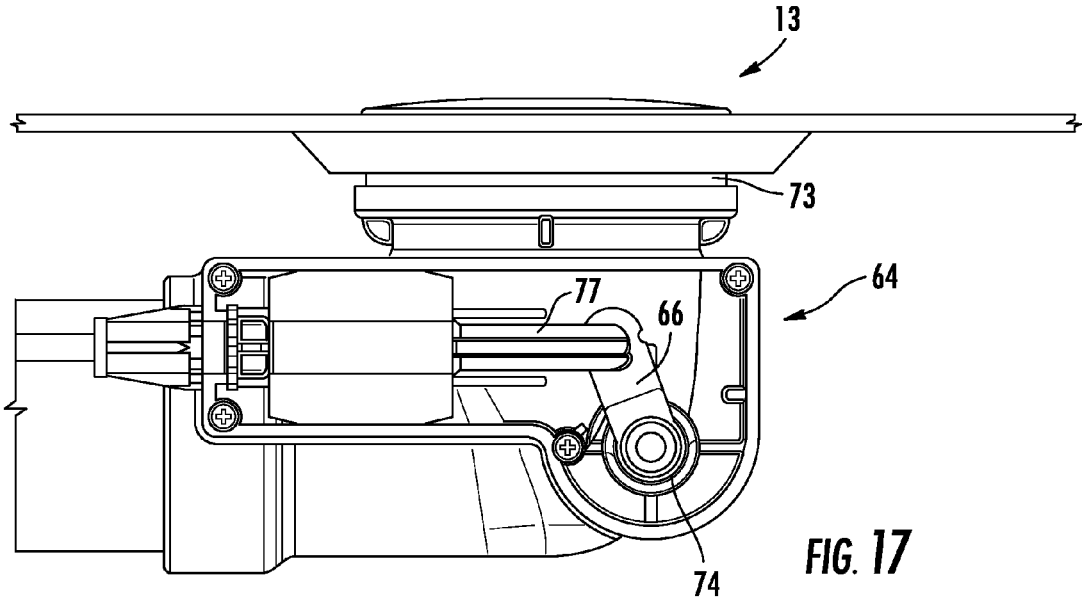


FIG. 17

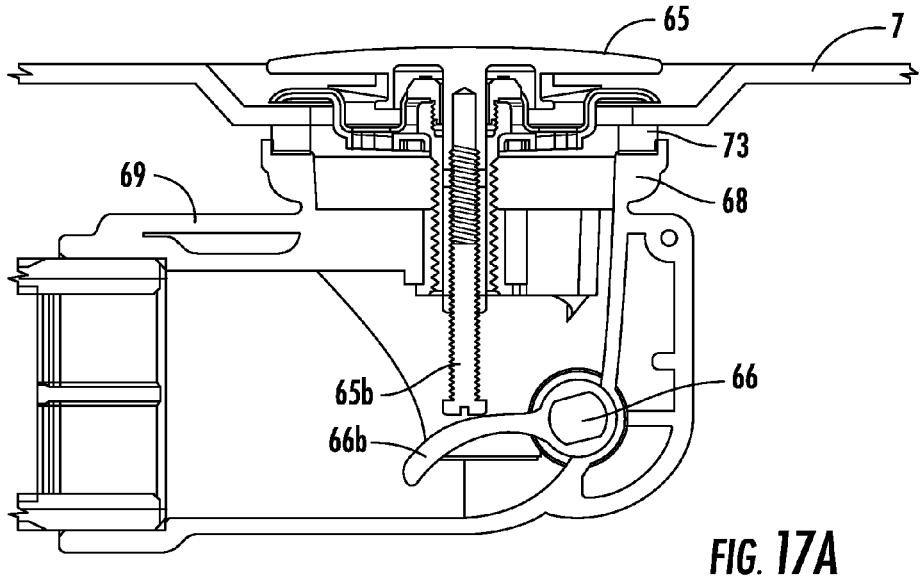
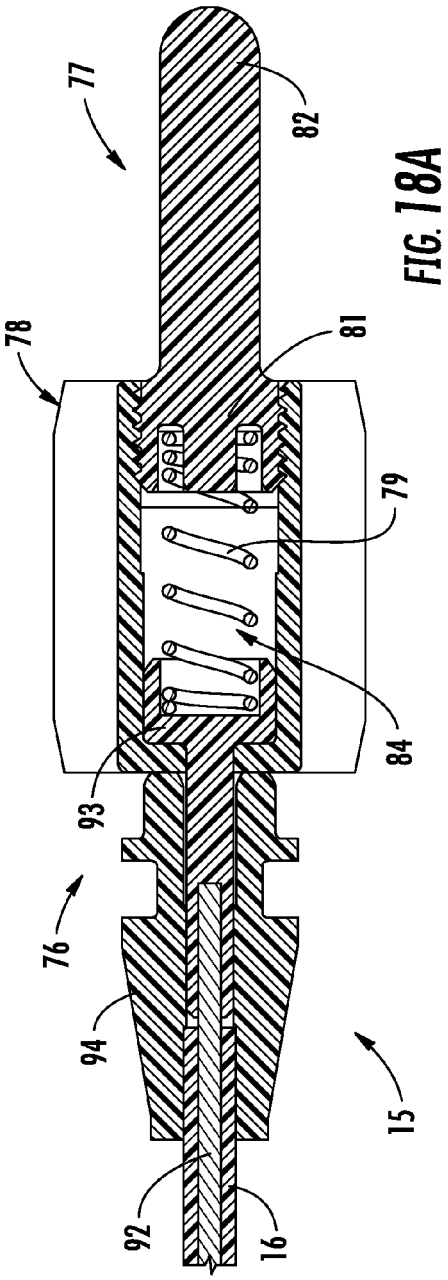


FIG. 17A



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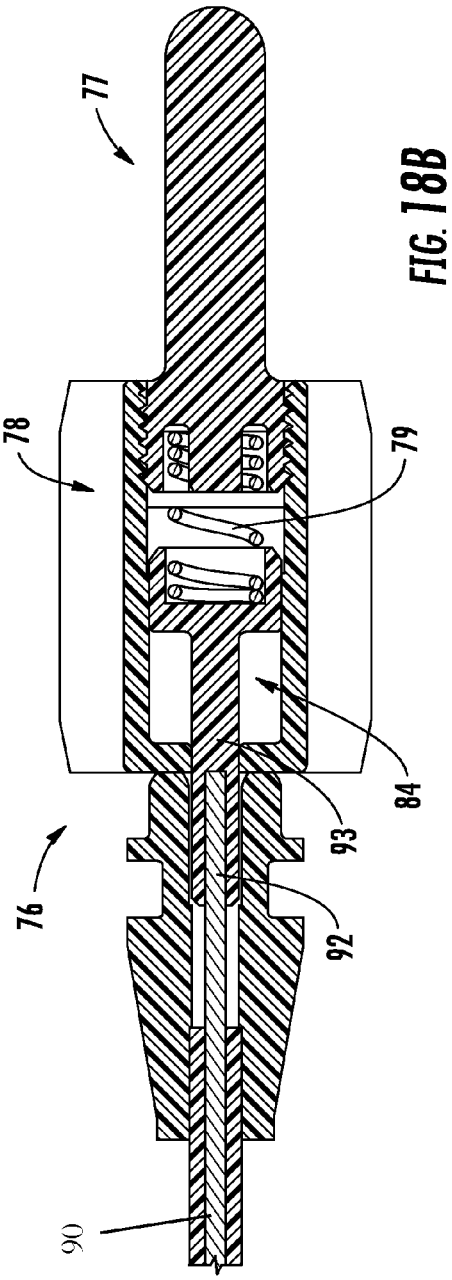

FIG. 18B

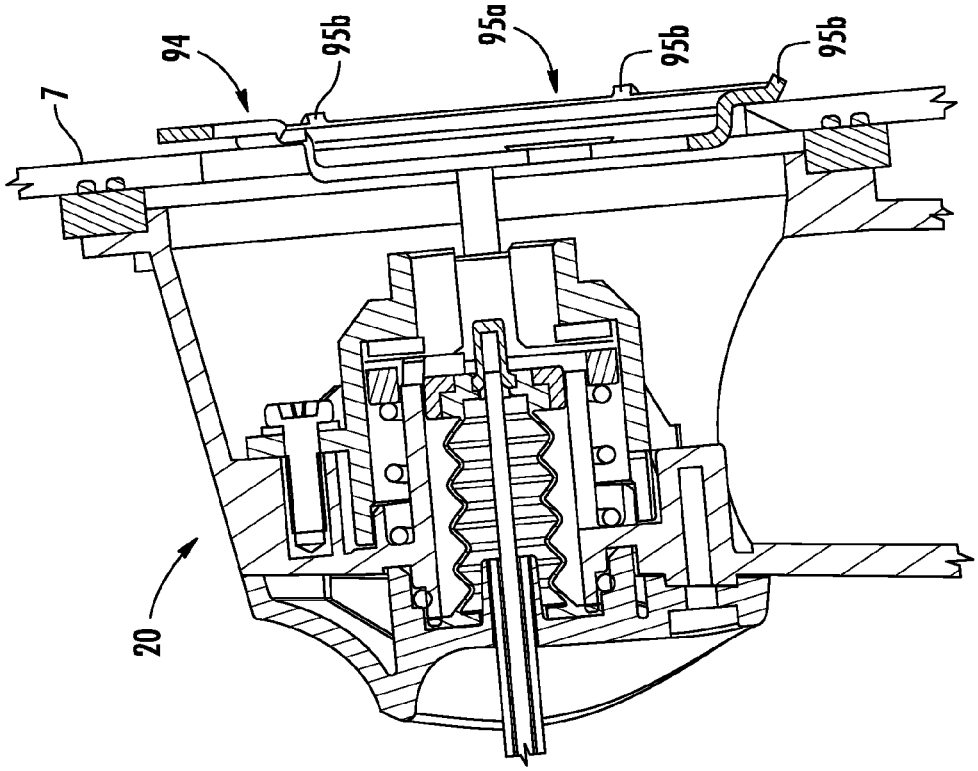

FIG. 20

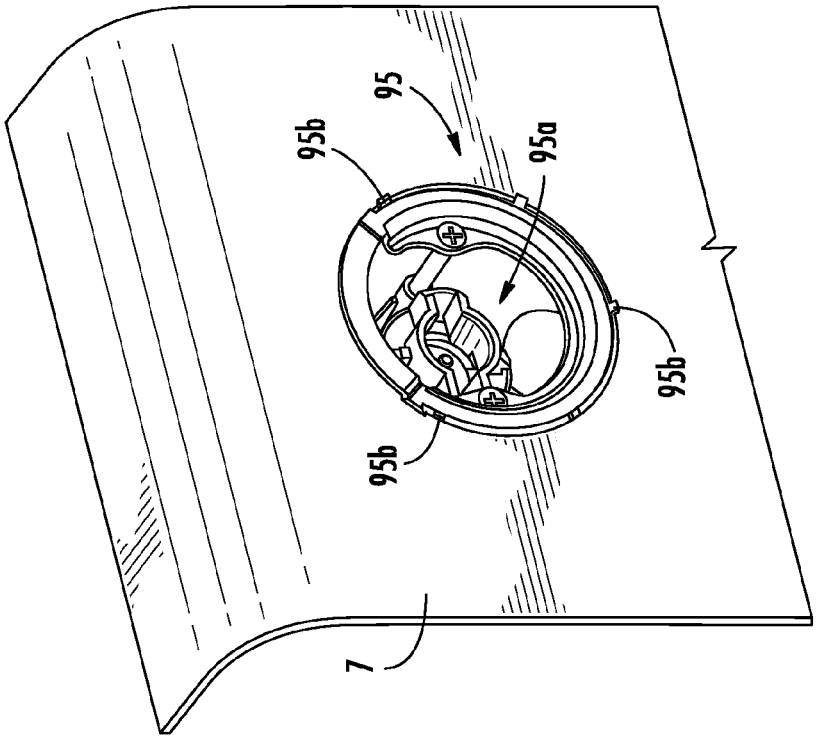

FIG. 19

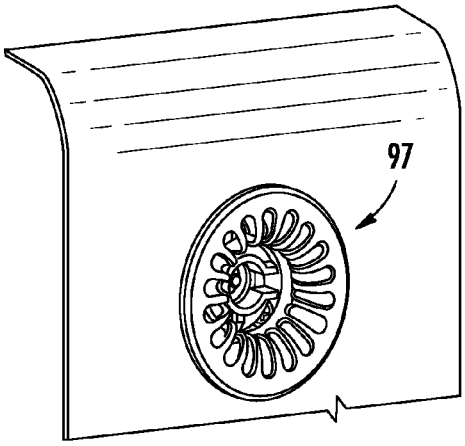

FIG. 21A

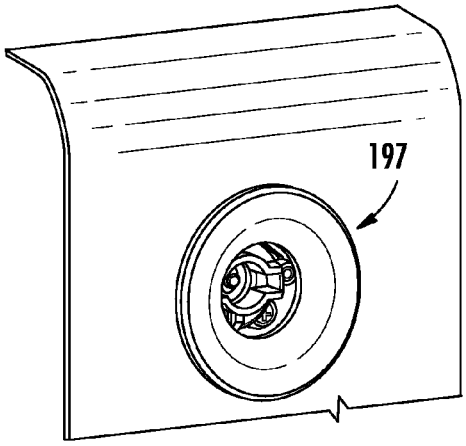

FIG. 21B

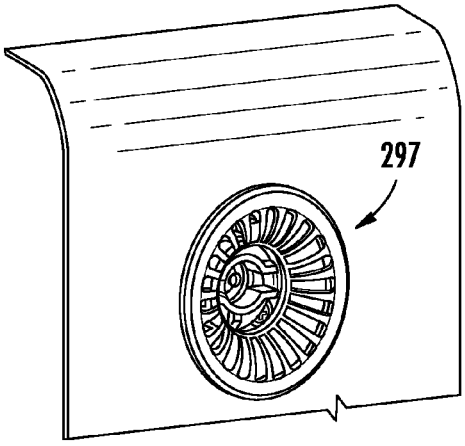

FIG. 21C

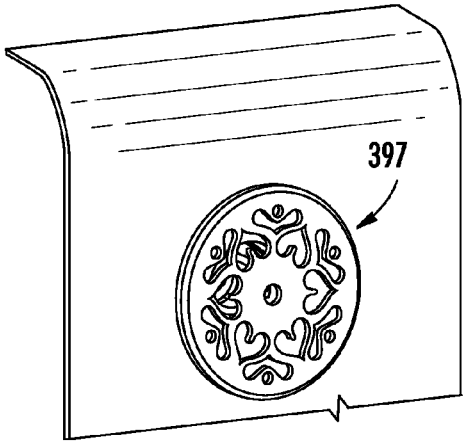

FIG. 21D

CABLE OVERLOAD DEVICE

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

This application claims the benefit of and priority to U.S. Provisional Patent Application No. 61/525,049, which was filed on Aug. 18, 2011. U.S. Provisional Patent Application No. 61/525,049 is incorporated by reference herein its entirety.

BACKGROUND

The present application relates generally to the field of drain systems for use in bathing tubs. More specifically, the present application relates to an improved drain system capable of being activated by either of interchangeable linear and rotary activators.

SUMMARY

One embodiment relates to a cable overload device for a cable-actuated drain system that includes a drain valve assembly and a drain control assembly where the cable includes a driving end connected to the control assembly and a driven end. The overload device includes a plunger, a linking member, a sleeve, and an energy absorber. The plunger is configured to be coupled to the driven end of the cable. The linking member is configured to move the drain valve assembly between open and closed positions. The sleeve includes a bore that extends from a first side to a second side of the sleeve, wherein the bore is configured to receive the plunger through the first side and to receive the linking member through the second side. The energy absorber is provided in the bore between the plunger and the linking member to absorb a force imposed into the linking member from the drain valve assembly.

Another embodiment relates to a drain valve system for a fixture, such as a bathing tub. The drain valve system includes a housing, a drain stopper, a lever, a cable, and a cable overload device. The housing is configured to mount to a wall of the fixture and includes an opening. The drain stopper is configured to move within the opening between an open position and a closed position. The lever is pivotally coupled to the housing and includes a first arm and a second arm, where the first arm is configured to move the drain stopper upon rotation of the lever. The cable includes a driven end and a driving end that is connected to a drain control assembly configured to move the cable. The cable overload device includes a plunger, a linking member, a sleeve, and an energy absorber. The plunger is coupled to the driven end of the cable. The linking member includes a first end and a second end coupled to the second arm of the lever, such that movement of the linking member rotates the lever. The sleeve includes a first side that receives the driven end and a second side that receives the linking member. The energy absorber is disposed between the plunger and the linking member to absorb a force imposed into the linking member from the drain stopper.

Yet another embodiment relates to a cable overload device for a cable-actuated drain system that includes a drain stopper and a control assembly. The overload device includes a cable, a linking member, a sleeve, and an energy absorber. The cable includes a driven end and a driving end connected to the control assembly, which is configured to move the cable. The linking member is configured to move the drain stopper between an open position and a closed position. The sleeve includes a first side that receives the driven end and a second side that receives the linking member. The energy absorber is provided between the driven end and the linking member to absorb a force imposed into the linking member from the drain stopper.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a drain system, according to an exemplary embodiment.

FIG. **2** is a side view of the drain system of FIG. **1**.

FIG. **3** is cross-sectional view of the control assembly of the drain system, shown without the actuator engaging the housing.

FIG. **4** is a perspective view showing the actuator being moved into engagement with the housing of the control assembly.

FIG. **5**A is a cross-sectional view of the control assembly of FIG. **2** with the actuator engaging the housing in a closed position.

FIG. **5**B is a cross-sectional view of the control assembly of FIG. **2** with the actuator engaging the housing in a open position.

FIG. **6** is a perspective view of an exemplary embodiment of a clicker cartridge actuator.

FIG. **6**A is a cross-sectional-view of the actuator of FIG. **5**.

FIG. **7** is a perspective view of an exemplary embodiment of a rotary cartridge actuator.

FIG. **7**A is a cross-sectional view of the actuator of FIG. **6**.

FIG. **8** is a perspective view of an exemplary embodiment of a housing of the control assembly.

FIGS. **8**A and **8**B are cross-sectional views of the housing of FIG. **8**.

FIG. **9** is an exploded perspective view of an exemplary embodiment of an actuator.

FIG. **10** is a perspective view of the actuator of FIG. **9**.

FIG. **10**A is a cross-sectional view of the actuator of FIG. **10**.

FIG. **11** is a perspective view of another exemplary embodiment of an actuator.

FIG. **12** is a perspective view of another exemplary embodiment of a control assembly having a rotary activated driving member engaged to the housing.

FIG. **12**A is a cross-sectional view of the control assembly of FIG. **12**.

FIG. **12**B is a perspective view of the control assembly of FIG. **12**, however, with a linear activated driving member engaged to the housing.

FIG. **12**C is a cross-section al view of the control assembly of FIG. **12**B.

FIG. **13** is a perspective view of the housing of the control assembly of FIG. **12**.

FIG. **14** is a perspective view of a driven member for use in a control assembly, such as the control assembly of FIG. **12**.

FIG. **15**A is a perspective view of a rotary activated driving member for use in a control assembly, such as the control assembly of FIG. **12**.

FIG. **15**B is a perspective view of the driving member of FIG. **15**A with a handle coupled thereto.

FIG. **15**C is a perspective view of a linear activated driving member for use in a control assembly, such as the control assembly of FIG. **12**B.

FIG. **15**D is a perspective view of the driving member of FIG. **15**C with a handle coupled thereto.

FIG. **16** is a side view of an exemplary embodiment of a drain valve assembly having a cable overload device, where the drain valve is shown in the open valve position.

FIG. **16**A is a cross-sectional view of the drain valve assembly of FIG. **16**.

FIG. **17** is a side view of drain valve assembly of FIG. **16**, shown in the closed valve position.

FIG. **17**A is a cross-sectional view of the drain valve of FIG. **17**.

FIG. **18**A is a cross-sectional view of an overload device for a drain valve assembly, shown in the normal use position.

FIG. **18**B is a cross-sectional view of an overload device for a drain valve assembly, shown in the loaded use position.

FIG. **19** is a perspective view of a mounting plate coupled to the housing of the control assembly with a portion of the bathing tub provided between the mounting plate and housing.

FIG. **20** is a front view of the mounting plate of FIG. **19**.

FIGS. **21**A-**21**D are perspective views of various exemplary embodiments of escutcheons that may be interchangeably used to tailor the aesthetics of the drain system.

DETAILED DESCRIPTION

With general reference to the Figures, disclosed herein are improved drain systems for use in bathroom devices, such as bathing tubs, that generally may include drain valve assemblies configured to switch between open and closed positions in order to permit or prohibit water from flowing through the drain valve, such as from the basin of the tub. The drain systems may also include control assemblies that are configured to control the opening and closing of the drain valve assemblies through manipulation of an actuator by the user. The control assemblies may be configured to receive different types of actuators that have similarly configured key-way engaging features (or members) to provide flexibility to the user to select a preferred method of actuation without having to replace the portion of the control assembly that is coupled to the bathroom device. For example, the user has the option to utilize (or switch between) a linearly manipulated actuator or a rotary manipulated actuator for controlling the drain valve position through the control assembly. Further the different actuators may be switched without having to enlist the services of a professional and without the use of tools. The drain systems may further include cable assemblies that communicate between the control assemblies and the drain valve assemblies to control the operation thereof. The cable assemblies may be incorporated with an overload device or assembly to prevent damage to the drain system (e.g., the cable assembly), such as in the event a user steps on an open drain valve. Additionally, the drain valve systems disclosed herein may include aesthetic escutcheons, that may be easily replaced by the user without having to replace any of the hardware (e.g., the control assemblies, the drain valve assemblies) to allow the user to tailor the aesthetics of the drain valve systems, such as to match other fixtures in the bathroom, without the cost and difficulty of replacing the hardware of the systems.

FIGS. **1** and **2** illustrate an exemplary embodiment of a drain system **10** that generally includes a control assembly **11**, a drain valve assembly **13**, and a cable assembly **15**. The cable assembly **15** is configured to communicate an input to the control assembly **11**, such as by a user, to control the operation of the drain valve assembly **13**. The drain system **10** may be utilized within a bathroom device, such as a bathing tub, for controlling the opening and closing of the drain valve assembly **13** through manipulation of the control assembly **11**. In the open position, the drain valve assembly **13** permits liquid (e.g., water) to flow through the drain valve assembly **13** to exit the bathing tub. In the closed position, the drain valve prohibits liquid (e.g., water) from flowing through the drain valve assembly **13**, thereby retaining the liquid in the basin of the bathing tub, such as to provide a bathing feature to the user of the tub.

The drain system **10** may also include one or more drainpipes **17** to carry or transfer the water from the drain system **10** to the sewer system or another component (e.g., plumbing) of the sewer system. For example, the drain system **10** may include a first drainpipe **17***a* and a second drainpipe **17***b*, where the first drainpipe **17***a* is in fluid communication with the overflow drain to transfer the water that enters the overflow drain and where the second drainpipe **17***b* is in fluid communication with the drain valve assembly **13** to transfer the water that enters the drain valve assembly **13**. The first drainpipe **17***a* and the second drainpipe **17***b* may meet, such as at an elbow connection, to be in fluid communication with each other and the drainpipe **17***c*, which may transfer the water to the sewer system. Accordingly, water that enters either the first or second drainpipes **17***a*, **17***b* may exit through drainpipe **17***c*.

FIGS. **3**-**10**A illustrate an exemplary embodiment of the control assembly **11** (e.g., a drain control assembly). The control assembly **11** is shown as including a housing **20**, a switching mechanism **21**, and an actuator **22** configured to selectively engage the housing **20** and to control the switching mechanism **21**. For example, the control assembly **11** may include a receiving member **24** that is disposed within the housing **20** and is configured to receive the actuator **22**. The receiving member **24** may be formed separately from the housing **20** then coupled thereto or may be integrally formed with the housing **20**. When engaged with the receiving member **24** in the housing **20**, the actuator **22** is configured to be moved between a first position (e.g., open position), as shown in FIG. **5**B, and a second position (e.g., closed position), as shown in FIG. **5**A, to correspondingly move the drain valve assembly **13** between a first open position and a second closed position through the cable assembly **15**.

As shown in FIGS. **3**, **5**A, **5**B, the housing **20** may include a mounting base **25** for fixing the housing **20** in place, such as to a wall **7** of the bathing tub or any suitable bathroom fixture. The housing **20** may also include an outer wall **26** that extends from the base **25** and a rear portion **27** that extends from the outer wall **26**, whereby the outer wall **26** and the rear portion **27** may enclose a switching mechanism **21** provided in the housing **20**. The base **25** may include a stepped annular portion that may be configured to be inserted into a hole in the wall of the tub to thereby engage the wall **7**. The annular base **25** may include a central opening **28** in which the actuator **22** may pass therethrough to engage a retaining channel **30** (e.g., a receiving portion) formed in the housing **20**. The base **25** may further include one or more openings or apertures, such as on the annular portion, for receiving fasteners to couple the housing **20** to the bathroom fixture. The rear portion **27** may include an opening **29** that is configured to receive a portion of the cable assembly **15**. The opening **29** may be provided in the back of the rear portion, along the sides, or may be located anywhere on the rear portion **27**. In other words, the cable assembly **15** may extend in a rearward direction out the back of the housing **20** through the opening **29** in the rear portion **27** or may extend in a direction that is transverse to the rearward direction out the sides, top, or bottom of the rear portion **27** (or the housing **20**).

The retaining channel **30** of the housing **20** is configured to receive and retain the actuator **22** to thereby permit manipulation of the actuator **22** by a user to control the switching mechanism **21**. The retaining channel **30** may include an opening **31** that receives the actuator **22** or a portion thereof.

Accordingly, the shape of the opening **31** may be varied and may be tailored to accommodate the shape of the actuator **22** (or portion of the actuator **22**), which may also be varied. As shown in FIGS. **8**-**8**B, the opening **31** may include a circular portion and two opposing rectangular portions extending from the circular portion. The retaining channel **30** may also include a passage **32** that extends from the opening **31** to allow the portion of the actuator **22** that is inserted through the opening to move through the passage **32**. The passage **32** may be helical shaped, where upon rotation or twisting of the actuator **22** the portion of the actuator **22** that engages the retaining channel **30** moves along the passage **32** to a retaining position where the actuator **22** is selectively locked into engagement with the receiving member **24** in the housing **20**. The actuator **22** may be configured to selectively lock into engagement with the receiving member **24** upon a predetermined angular rotation, such that to unlock the actuator **22** from the housing **20** a threshold force needs to be applied to the actuator (e.g., a compression force). The retaining channel **30** may include a recess **33** at the end of the rotational travel that is offset from the helical passage **32** in the direction that is opposite the direction the actuator **22** is inserted into engagement with the housing **20**. For example, the recess **33** may be in the form of a fore and aft extending cutout that is configured to receive and retain a portion (e.g., the member **155**, **255**) of the actuator.

The control assembly **11** may include a biasing member **35** provided in the housing **20** to provide a force to bias the portion of the actuator **22** that engages the retaining channel **30** of the housing **20** into the recess **33** to lock the actuator **22** and the housing **20**. The biasing member **35** may be a spring, such as a coil spring or helical spring that may provide the force when compressed in an axial direction. The biasing member **35** may be located in a cylindrical bore **34** within the housing **20**, where the bore **34** is configured to retain the biasing member **35** in place, such as by limiting movement of the biasing member **35** in a direction that is transverse to the axial direction, but allows for the biasing member **35** to move (e.g., compress, expand) in the axial direction. The biasing member **35** may include a first end **36** and a second end **37**, where the first end **36** engages the bore **34** of the housing **20** to limit travel of the biasing member **35** and the second end **37** is configured to apply the biasing force to the actuator **22** directly or indirectly (such as through an intermediate member).

The control assembly **11** may further include a seal or gasket **19** to prohibit the leaking of water. As shown in FIG. **3**, the gasket **19** may be provided between the base **25** of the housing **20** and the wall **7** of the bathing tub to prohibit the leaking of water therebetween. For example, the gasket **19** may be generally annular shaped to reside in an annular shaped groove formed between the base **25** and the wall **7**. However, the gasket may be provided at any suitable location and may be configured to have any suitable shape. Additionally, the control assembly **11** may include a plurality of gaskets.

When the actuator **22** is inserted into the retaining channel **30** of the housing **20**, the biasing member **35** is compressed by the actuator **22** storing energy within the biasing member **35**. When the actuator **22** is twisted the predetermined angular rotation, such that the engaging features of the actuator **22** are aligned with the recess **33**, the biasing member **35** releases stored energy to bias the engaging features of the actuator **22** into the selectively locked position with the recess **33**. To unlock the actuator **22** from the housing **20**, the user applies enough force (e.g., a compression force of around 20 lbs) to overcome the biasing force of the biasing member **35** that retains the engaging features (e.g., the member **155**, **255**) of the actuator **22** into the recess **33**, which moves the engaging features into alignment with the passage **32** where the user can disengage the actuator **22** from the housing **20** through rotation of the actuator **22**.

The control assembly **11** may also include a washer **38** provided as an intermediate member between the second end **37** of the biasing member **35** and the actuator **22**. The washer **38** may be configured to slide along the cylindrical bore **34** of the receiving member **24** in the housing **20** when a force is applied on the washer **38**, such as from the biasing member **35** and/or from the actuator **22**. The washer **38** may be cylindrical or annular shaped, such as to fit in the cylindrical bore, or may have any suitable shape to tailor the shape of the washer to the shape of the bore.

The switching mechanism **21** is configured to move a driving end **91** of the cable assembly **15** between the first open and second closed positions, upon activation by the actuator **22**. The switching mechanism **21** may include a sliding member **40** that is configured to move the driving end **91** of the cable assembly **15** when the actuator **22** is activated. Thus, the sliding member **40** is configured to move (e.g., slide) in a bore of the receiving member between a first and a second position, which correspond to the first and second positions of the switching mechanism **21**. The sliding member **40** may receive and/or may be coupled to the driving end **91** of the cable assembly **15**, such that movement of the sliding member **40** results in a corresponding movement of the driving end **91** of the cable. As shown in FIGS. **5**A and **5**B, the sliding member **40** may have an annular base **41**, an annular wall **42** that extends from the annular base **41**, and a cylindrical portion **43** that extends from the annular base **41**. The cylindrical portion **43** may include a bore **44** that is configured to receive the driving end **91** of the cable. The sliding member **40** and the driving end **91** of the cable may be coupled together using any suitable method, such as crimping. The cylindrical portion **43** may extend a length beyond the annular base **41** to allow for enough length between the driving end **91** of the cable and the sliding member **40** to provide a good crimp or couple.

The sliding member **40** of the switching mechanism **21** may be configured to be received within a second bore **39** in the receiving member **24** in the housing **20**. The wall of the housing **20** that defines the second bore **39** may be configured to guide the sliding member **40** during movement within the second bore **39** to allow for efficient relative movement between the housing **20** and the sliding member **40**.

The switching mechanism **21** may further include a seal **46** to prevent the exposure of the driving end **91** of the cable to water. The seal **46** may preferably have a bellows shape, as shown, to accommodate the movement (e.g., compression, expansion) induced by the sliding member **40**. However, the seal **46** may have any suitable shape that may prohibit the ingress of water and accommodate the movement. The seal **46** may be disposed in the second bore **39** in the receiving member **24** to enclose or partially enclose the driving end **91** of the cable. The bellows shaped seal **46** may be resilient, such that the seal **46** may be compressed by the sliding member **40** when the sliding member **40** is moved toward the seal **46**, yet the seal **46** springs back to an uncompressed state when the sliding member **40** is moved away from the seal **46**. Thus, the resilient seal **46** may provide a force to bias the sliding member **40**, such as into the first open position. The housing **20** (e.g., the rear portion **27**) may include a protrusion that guides the cable and further provides a lip for an end of the seal **46** to engage (e.g., contact) to prevent ingress of water beyond the seal **46**. The protrusion may be configured to retain the end of

the seal **46**. The other end of the seal **46** may engage (e.g., contact) the sliding member **40**.

The housing **20** and the switching mechanism **21** together form an assembly (e.g., a rough-in assembly, a kit, subassembly, etc.), which provides the function of the control assembly **11**. As shown in FIGS. **1** and **4**, an escutcheon **97** (e.g., faceplate) may be coupled to the control assembly **11** to provide improved aesthetics to the drain system, whereby the aesthetics may be tailored to accommodate customer preference by switching out escutcheons. The escutcheon **97** is discussed in greater detail below.

Additionally, the housing **20** of the control assembly **11** may be configured to act as the overflow for the drain system **10**, where the housing **20** may further include a drainpipe **17***a* for draining water that enters the overflow opening. The central opening **28** in the base **25** of the housing **20** may be the overflow opening, such that when the water in the tub rises to a level that is above the central opening **28**, the water enters the central opening **28** and passes into the drainpipe **17***a* to be carried to the sewer system. It should be noted that the control assembly **11** may be configured to include an overflow opening that is separate from the central opening **28**, where the overflow opening may be configured in any suitable manner (e.g., shape, location, size, etc.).

The housing **20** of the control assembly **11** may be configured to receive both a clicker cartridge actuator **122**, whereby the actuator **122** is activated through linear manipulation by the user, and a rotary cartridge actuator **222**, whereby the actuator **222** is activated through rotary manipulation by the user. Thus, the control assembly **11** provides the flexibility for the user to change the method of actuation of the drain system without having to replace or modify the rough-in assembly. Accordingly, the user can tailor the actuation of the drain system **10** to his or her own preferred method of actuation (e.g., linear, rotary), such as by simply switching between the actuator **122** and the actuator **222**. In addition, the drain systems disclosed herein allow for the user to tailor such actuation without having to rely on a professional to perform such a service. In fact, the user can switch the actuation method (e.g., the actuators) without the need of a tool or device to assist the user.

FIGS. **6** and **6**A illustrate actuator **22**, according to an exemplary embodiment, shown as a clicker cartridge actuator **122** to selectively engage the receiving member **24** in the housing **20** and to control the switching mechanism **21** of the control assembly **11**. When engaged with the receiving member **24**, the actuator **122** may be moved between a first open position and a second closed position through linear manipulation of the actuator **122**. In the open position, the actuator **122** moves the drain valve assembly **13** to an open position through the switching mechanism **21** and the cable assembly **15**, where water may drain through the drain valve assembly **13** from the bathing tub. In the closed position, the actuator **122** moves the drain valve assembly **13** to a closed position through the switching mechanism **21** and the cable assembly **15**, where water is prohibited from draining through the drain valve assembly **13** and therefore accumulates in the bathing tub. In other words, when linearly moved between the first and second positions, the actuator **122** in turn moves the sliding member **40** of the switching mechanism **21** between first and second positions, which in turn moves the driving end **91** of the cable assembly **15** between first and second positions to open and close the drain valve assembly **13**.

The actuator **122** may include a body **148**, an engaging feature **149**, and a biasing member **150** that together may form a cartridge unit. The actuator **122** may further include a handle **151** that is configured to engage the body **148**. The body **148** may be configured as a hollow cylinder that is open on one end to receive the engaging feature **149** and the biasing member **150** through the opening. The body **148** may include a coupling feature **152**, such as a threaded portion, for coupling the handle **151** thereto. The coupling feature **152** may be provided on the end of the body **148** that is opposite the open end. The body **148** may have a contact surface **157** (e.g., on the open end of the body) that is configured to contact the sliding member **40** of the switching mechanism **21**, such that motion of the body **148** relative to the engaging feature **149** in turn moves the sliding member **40**. The engaging feature **149** may include cylindrical portion **154** configured to slide within the hollow body **148** and a pair of members **155** that extend from opposing sides of the portion **154**. The member **155** may be any suitable shape, such as rectangular, to define a key-way that engages the opening **31** of the housing **20**. Upon rotation of the actuator **122**, the members **155** move along the passage **32** of the receiving member **24** in the housing **20** to selectively lock in the recess **33** to selectively engage the actuator **122** and the housing **20** (e.g., receiving member **24**).

The engaging feature **149** of the actuator **122** may also include a locking feature **156** that may selectively lock the actuator **122** into position, such as the first and/or second positions. As shown in FIG. **6***a*, the locking feature **156** may take the form of an A-shaped travel guide, wherein a pin coupled to (or an protrusion extending from) the body **148** may pass therein. When the actuator is configured in the second closed position, as shown in FIG. **5**A, the pin of the body **148** resides in the upper apex **156***a* of the A-shaped travel guide **156**. When the body **148** of the actuator **122** is depressed (or compressed or moved) toward the engaging feature **149**, the actuator may move from the second closed position to the first open position, as shown in FIG. **5**B, where the pin of the body **148** travels along the leg of the A-shaped travel guide **156** to a lower corner, then upward along the base at an oblique angle to reside in the lower apex **156***b*. When depressed (or activated), the body **148** moves relative to the engaging feature **149**, since the engaging feature **149** is retained by the housing **20**. To move the actuator back to the second closed position from the first open position, the body **148** is depressed (or compressed) thereby moving the pin of the body **148** along the base to a lower corner, then upward along the leg to the upper apex **156***a*. Thus, the actuator **122** is configured to move between the first and second positions through linear manipulation of the actuator **122** by the user, such as by linear motion of the body **148** relative to the engaging feature **149**. Further, when the actuator **122** is moved between the first and second positions, the contact surface **157** of the body **148** is configured to move the sliding member **40** of the switching mechanism **21** between corresponding first and second positions. It should be noted that the configuration of the locking feature **156** and/or the engaging feature **149** may be varied, and the embodiments disclosed herein are not limiting.

The biasing member **150** may be a spring (e.g., a coil spring, a helical spring, etc.) provided within the hollow cylinder of the body **148** between the engaging feature **149** and the body **148** to impart a biasing force that may act to move the body **148** and the engaging feature **149** in opposing directions. Thus, the force from the biasing member **150** may act to retain the pin of the body **148** within the upper apex **156***a* or the lower apex **156***b* to lock the actuator **122** into the respective closed position or open position.

As discussed above, the actuator **122** may be configured to be selectively coupled or engaged with the receiving member **24** in the housing **20**. For example, the actuator **122** may be

selectively coupled to receiving member **24** through applying a compression force, such as 20 lbs, in the direction of coupling or engagement. The compression force may drive the engaging feature **149** of the actuator **122** to be selectively coupled to the receiving member **24** (e.g., the passage **32** and the recess **33**). When engaged with the receiving member **24**, a user may actuate the actuator **122** by applying an activation force, such as 10 lbs, in the direction of activation to switch the drain system between the open and closed positions. The difference in the force to activate and the force to couple the actuator allows for the directions of activation and engagement to be substantially similar (e.g., parallel) directions. However, it should be noted that the direction of activation may be configured to be different than the direction of engagement.

FIGS. **7** and **7**A illustrate actuator **22**, according to another exemplary embodiment, shown as a rotary cartridge actuator **222** to selectively engage the receiving member **24** in the housing **20** and to control the switching mechanism **21** of the control assembly **11**. When engaged with the receiving member **24**, the actuator **222** may be moved between a first open position and a second closed position through rotational manipulation of the actuator **222**. In the open position, the actuator **222** moves the drain valve assembly **13** to an open position through the switching mechanism **21** and the cable assembly **15**, where water may drain through the drain valve assembly **13** from the bathing tub. In the closed position, the actuator **222** moves the drain valve assembly **13** to a closed position through the switching mechanism **21** and the cable assembly **15**, where water is prohibited from draining through the drain valve assembly **13** and therefore accumulates in the bathing tub. In other words, when rotationally moved between the first and second positions, the actuator **122** in turn moves the sliding member **40** of the switching mechanism **21** between first and second positions, which in turn moves the driving end **91** of the cable assembly **15** between first and second positions.

The actuator **222** may include a body **248** and an engaging feature **249** that together may form a cartridge unit. The actuator **222** may further include a handle that is configured to engage the body **248**. The body **248** may be configured to move relative to the engaging feature **249**, such that rotational motion of the body **248** is converted into linear translation of the body **248** toward or away from (depending on the direction of rotation) the engaging feature **249**. The engaging feature **249** may define a key-way having a cylindrical portion **254** with two members **255** extending therefrom, such as from opposing sides of the cylindrical portion **254**. Upon rotation of the actuator **222**, the members **255** move along the passage **32** of the receiving member **24** in the housing **20** to selectively lock in the recess **33** to selectively engage the actuator **222** and the receiving member **24**.

The engaging feature **249** of the actuator **222** may also include a locking feature that may selectively lock the actuator **222** into position, such as in the first and/or second positions. The actuator **222** is configured to move between the first and second positions through rotational manipulation of the actuator **222** by the user, such as by rotational motion of the body **248** relative to the engaging feature **249**. For example, when the body **248** is rotated in a first rotational direction (e.g., clockwise), the body **248** may move linearly toward the engaging feature **249**, and when the body **248** is rotated in a second rotational direction (e.g., counter-clockwise), the body **248** may move linearly away from the engaging feature **249**. The body **248** may include a contact surface **257**, such that when the body **248** moves relative to the engaging feature **249** the contact surface **257** moves the sliding member **40** of the switching mechanism **21** a corresponding distance. Thus, rotational motion of the body **248** of the actuator **222** results in linear movement of the contact surface **257** of the actuator **222** and the sliding member **40** that is in contact with the contact surface **257**.

The actuator **222** may further include a biasing member to provide a biasing force onto the actuator **222** or onto one or more portions thereof, such as between the body **248** and the engaging feature **249**. The biasing member may be a spring (e.g., a coil spring) that imparts a biasing force, such as to act to move the body **148** and the engaging feature **149** in opposing directions, or may have any suitable configuration.

The actuators **122**, **222** have similarly configured key-way features of the engaging features **149**, **249** that are configured to engage the same (or common) receiving member **24** in the housing **20** and control the switching mechanism **21** therein. This allows the user to switch between the linearly activated actuator **122** and the rotary activated actuator **222** based on the user preference. This provides flexibility to the user to be able to have a preferred actuation method without having to replace or modify the rough-in assembly (e.g., the hardware coupled to the wall of the fixture) or without having to enlist the services of a professional, such as to change actuators.

As shown in FIGS. **9-11**, the actuator may be configured to include a handle that the user manipulates to move the actuator between the first and second positions. FIGS. **9-10**A illustrate the actuator **22**, according to another exemplary embodiment, shown as actuator **322**. The actuator **322** may include a body **348** and an engaging feature **349** that together may form a cartridge unit. The actuator **322** may also include a handle **359** and a lock ring **360** to secure the handle **359** to the body **348** of the cartridge unit. The actuator **322** is configured to provide height adjustability (e.g., adjustment along the longitudinal axis of the body **348**) of the handle **359** relative to the body **348** without the assistance of tools. Because the walls of the bathing tubs vary in thickness, the height adjustability of the actuator **322** allows a common actuator **322** to be used in conjunction with varying thickness tubs, while providing a proper fit between the tub and actuator **322**.

The handle **359** may have any suitable shape and size, and may include a sleeve **359***a* that is configured to receive the lock ring **360** and/or the body **348** of the cartridge unit. The sleeve **359***a* of the handle **359** may include one or more threads **359***b* (e.g., ribs, projections, etc.) that are configured to secure the handle **359** to the lock ring **360** and/or the body **348**. The threads **359***b* may extend outwardly from the outer surface of the sleeve **359***a*, may extend inwardly from the inner surface of the sleeve **359***a*, or may extend having a combination thereof. Each thread **359***b* may extend any suitable length, such as an arc length that is less than the full circumference of the sleeve **359***a*. For example, the sleeve **359***a* may include two threads **359***b* (e.g., outwardly extending threads), where each thread **359***b* extends only a portion of the circumference (e.g., about one-fifth to one-fourth of the total arc length). The lock ring **360** has an opening **360***a* that is similar to the shape and size defined by the sleeve **359***a* and threads **359***b* of the handle **359**, so that the handle **359** may be inserted into the lock ring **360**.

The body **348** of the actuator **322** may include external grooves **348***a* (e.g., threads, splines, protrusions) that are separated by one or more slots **348***b*. The lock ring **360** includes arms **360***b* that are configured to slide in the slots **348***b*, as the lock ring **360** moves (or slides) relative to the body **348**. Accordingly, the coupled handle **359** and lock ring **360** are able to slide along the length of the body **348** of the actuator **322**, as the arms **360***b* slide in the slots **348***b*, to provide height adjustability. Once the desired height of the

handle **359** relative to the body **348** is achieved, the handle **359** may be rotated relative to both the lock ring **360** and the body **348**, whereby the threads **359***b* of the handle **359** engage the grooves **348***a* of the body **348** to lock the position of the handle **359**. The lock ring **360** may have an engaging feature (e.g., thread, recess, groove, channel, etc.) that receives the threads **359***b* when the handle is rotated. The arms **360***b* may also impart a retaining force to secure the handle **359** to the body **348** of the actuator **322**.

Alternatively, as shown in FIG. **11**, the handle **459** may include internal threads provided on an interior of the sleeve portion of the handle that screw over the external threads **452** of the body **438** to thereby couple the handle **459** and body **438** together. The actuator **422** may further include a set screw **461** (or other suitable fastening device) to secure the handle **459** to the body **438** to prevent inadvertent relative rotation about the engaged threads.

FIGS. **12**-**15**D illustrate another exemplary embodiment of a control assembly **511** that is configured to move a cable **513** between a first position and a second position, such that the first position may correspond to a first open position of a drain valve assembly where the water is able to drain from the tub through the drain valve and the second position may correspond to a second closed position of the drain valve assembly where the water is prohibited from draining from the tub through the drain valve. The control assembly **511** is configured to provide flexibility to the user by allowing the user to change the method of actuation between rotary and linear input methods, such as by changing the driving member of the control assembly. In other words, the user can tailor the actuation method of the control assembly **511** by simply switching between a rotary activated driving member and a linear activated driving member.

The control assembly **511** includes a housing **520** that is configured to selectively receive both a first driving member **518** that is activated (e.g., controls the function of the drain valve assembly) through rotary movement and a second driving member **618** that is activated through linear movement. The control assembly **511** also includes a driven member **519** that is configured to be moved by the driving member **518**, **618** to control the movement of the cable **513** between the first and second positions to control the function of the drain valve assembly. The housing **520** is configured to support the driving member **518** and/or the driven member **519**.

As shown in FIGS. **12**A and **12**C, the control assembly **511** may also include a biasing member **517**. The biasing member **517** is configured to impart a biasing force into, for example, the driving member **518**, such as to bias the driving member **518** to aid in retaining the driving member **518** into engagement with the housing **520**. For example, the driving member **518** may have a key-way feature that passes into an opening of the housing, whereupon rotation of the driving member **518** the key way feature of the driving member **518** is out-of-phase with the opening of the housing **520**, such that a portion of the key-way is blocked by a portion of the housing to prohibit removal of the driving member **518** from the housing **520** (without further rotation). The biasing member **517** may impart a force into the driving member **518** to retain it into position to thereby maintain engagement of the driving member **518** to the housing **520**.

As shown in FIG. **13**, the housing **520** may include a base **525** and a wall **526** (e.g., a peripheral wall) that extends from the base **525**. The base **525** may define a first cavity **527**, in which the driven member **519** pivots therein, and a second cavity **528**, in which the driving member **518** rotates therein. The base **525** may also include an opening **529** (see FIG. **12**) for the cable **513** to pass therethrough, such as to engage the driven member **519**. The first cavity **527** may include a post **530** to pivotally support the driven member **519**. For example, the post **530** may be round in shape to engage a mating round hole in the driven member **519** to allow the driven member **519** to pivot about the round post **530**.

As shown in FIGS. **12**A and **15**A, the rotary activated driving member **518** includes an elongated body **532** and a contact surface **533**, where the body **532** defines a longitudinal axis **532***a*. The driving member **518** also includes an end **540** that is configured to be received by the second cavity **528** of the housing **520**, such that the driving member **518** may slide axially along the longitudinal axis **532***a* relative to the housing **520** to selectively engage (e.g., connect) the driving member **518** to the housing **520**. The driving member **518** is also configured to rotate about the longitudinal axis **532***a* relative to the housing, such as to move the cable **513** through the driven member **519**. The contact surface **533** may contact the driven member **519**, and may be configured having an oblique angle relative to the longitudinal axis **532***a*. The contact surface **533** may also be configured to extend along an arm **534** extending from the end **540**. As shown in FIGS. **15**A and **15**B, the driving member **518** may also include a feature for coupling a handle **544** thereto. For example, the body **532** may include an aperture **541** in the end opposite the end that engages the housing **520**, wherein the aperture **541** may receive a fastener for coupling the handle to the driving member. As another example, the body **532** may include grooves or threads that receive corresponding grooves or threads in the handle, or may another connection, such as discussed herein.

As shown in FIGS. **12**C and **15**C, the linear activated driving member **618** includes an elongated body **632** and a contact surface **633**, where the body **632** defines a longitudinal axis **632***a*. The driving member **618** also includes an end **640** that is configured to be received by the second cavity **528** of the housing **520**. For example, the end **640** may be circular in shape, and may include members **641** (e.g., semi-circular members) extending therefrom to form a key-way feature for selectively engaging the driving member **618** to the housing **520**. The driving member **618** is configured to slide axially along the longitudinal axis **632***a* relative to the housing **520** to selectively engage (e.g., connect) the driving member **618** to the housing **520**. The body **632** of the driving member **618** is also configured to move (e.g., slide) along the longitudinal axis **632***a* relative to the end **640**, such as to move the driven member **519** to thereby move the cable **513**. The contact surface **633** is configured to contact the driven member **519**, and may be configured having an oblique angle relative to the longitudinal axis **632***a*. When the body **632** is moved relative to the end **640**, the contact surface **633** moves along the oblique surface (e.g., the ramp) of the contact surface **537** of the driven member **519**, causing the driven member **519** to rotate. As shown in FIG. **15**D, the driving member **618** may also include a feature for coupling a handle **644** thereto.

As shown in FIG. **14**, the driven member **519** may be an elongated member having a first end **535**, a second end **536**, and a contact surface **537**. The first end **535** may include a round opening **538** that defines a pivot axis, in which the driven member **519** pivots thereabout. The size (e.g., diameter) of the opening **538** in the first end **535** may be tailored to size the post **530** in the first cavity **527**, such that the driven member **519** pivots in an efficient manner about the post **530** of the housing **520**. The second end **536** may retain an end **513***a* of the cable **513**, such that when the driven member **519** pivots about the post **530**, the second end **536** rotates relative to the first end **535** to thereby move the end **513***a* of the cable **513** a predetermined length. The second end **536** may include a retaining feature **539** to retain the end **513***a* of the cable **513**.

As shown in FIG. **12**, the end **513***a* of the cable **513** may include a ball-type fitting. Accordingly, the retaining feature **539** may be a spherical shaped void that receives the ball-fitting of the end **513***a* of the cable **513**. This configuration allows the ball-fitting to pivot relative to the second end **536** of the driven member **519**, as the end **513***a* is moved by the pivoting driven member **519**. As another example, the retaining feature **539** may be generally cylindrical in shape having an L-shaped opening in the second end **536** to allow the ball-type fitting to be inserted into the retaining feature **539** wherein the L-shaped opening retains the cable. As shown in FIG. **12**A, the contact surface **537** of the driven member **519** is configured to contact the contact surface **533** of the driving member **518**, such that rotation of the driving member **518** causes the driven member **519** to pivot about the pivot axis of the first end **535**. The contact surface **537** of the driven member **519** may be configured at an oblique angle that is similar to the contact surface **533** of the driving member **518**, or may have any suitable configuration that allows for the movement of the driven member **519**.

The driving member **618** is configured to be moved (e.g., slide) between first and second positions, such as by a linear input manipulation by a user into the driving member **618** or a handle **644** coupled thereto. Movement of the driving member **618** between the first and second positions moves the driven member **519** and cable **513** coupled thereto between the first and second positions of the cable **513**. When the driving member **618** is moved linearly along the longitudinal axis **632***a*, such as between the first and second positions, the contact surface **633** moves a corresponding amount, where the contact surface **633** of the driving member **618** being in contact with the contact surface **537** of the driven member **519** acts like a ramp to drive the rotation of the driven member **519** about the first end **535**.

Alternatively, the driving member **518** is configured to be moved (e.g., rotated) between third and fourth positions, such as by rotary input manipulation by a user. The driving member **518** is configured to rotate about the longitudinal axis **532***a*, such as relative to the second cavity **528** of the housing **520**, between the third and fourth positions to move the driven member **519** and cable **513** coupled thereto between the first and second positions of the cable **513**. When the driving member **518** is moved rotationally between the third and fourth positions, the arm **534** rotates a corresponding amount, where the arm **534** acts like a lever to induce movement (e.g., rotation) of the driven member **519** about the post **530** of the housing **520**. The contact surface **533** may extend along a surface of the arm **534**, or alternatively the arm **534** may have a second contact surface that extends along a face of the arm **534** in a radial direction from the body **532**, where the second contact surface may contact the driven member **519** to drive rotation of the driven member **519** upon rotation of the driving member **518**.

As the driven member **519** pivots about the post **530**, the second end **536** moves the retained end **513***a* of the cable assembly **15**. The second end **536** of the driven member **519** is configured to pivot about an arc that corresponds to a change in length of the cable that moves the cable between first and second positions, which in turn switches the drain valve assembly between the open and closed positions. Accordingly, it should be noted that the arc length that the driven member pivots can be varied to vary the change in length of the cable to accommodate different cable stroke lengths, such as for different configurations of drain valve assemblies.

FIGS. **16-18**B illustrate an exemplary embodiment of the drain valve assembly **13**. The drain valve assembly may include an overload device (or assembly) that is configured to limit the load (e.g., the force) transferred through the cable to the coupled components of the control assembly and/or the drain valve assembly. In effect, the overload device provides a designed safety margin to the components of the drain valve assembly. For example, if a person steps on the drain stopper, only a portion of the weight of the person may be transferred through the drain valve assembly because a portion of the weight is managed through the overload device.

The drain valve assembly **13** may include a housing **64**, a drain stopper **65**, and a rotatable lever **66**. The housing **64** may be coupled to a bathroom device or fixture, such as to a bathing tub, and may support the drain stopper **65** and the rotatable lever **66**. The drain stopper **65** may be configured to move between a first open position and a second closed position. In the open position, the drain stopper **65** allows water to drain through the drain valve assembly **13** from the bathing tub, such as through a drain hole or opening. In the closed position, the drain stopper **65** prohibits water from draining through the drain valve assembly **13** to allow water to accumulate, such as in the basin of the bathing tub. The rotatable lever **66** is configured to be rotated, such as by movement of the cable assembly **15**, to in turn move the drain stopper **65** between the open and closed positions.

The housing **64** may include a base **68** for fixing the housing **64** in place, such as to a wall **7** or an opening in the wall of the bathing tub or to any suitable bathroom fixture. The base **68** may be annular in shape having an opening, such as the central opening **68***a*, to allow the drain stopper **65** to pass therethrough, as well to allow the water from the tub to enter the housing **64**, such as when the drain stopper **65** is the open position. The housing **64** may also include an outer wall **69** that extends from the base **68** to form or define a cavity **70** therein. The wall **69** may have an annular or tubular cross-section (e.g., circular) that extends having any suitable shape (e.g., linear, elbow, curved). The cavity **70** is in fluid communication with the opening **68***a* in the base **68**, such that water entering the housing **64** through the opening **68***a* passes into cavity **70**. The end of the wall **69** (e.g., the end that is opposite to the end that abuts the base) may be coupled to a drainpipe, such as the drainpipe **17***b* (as shown in FIG. **1**), whereby the cavity **70** may be in fluid communication with a cavity that is defined by a drainpipe, such as drainpipe **17***b*. The wall **69** may include a support **69***a* that may be configured to support and/or guide the drain stopper **65**. The wall **69** may also include an opening **69***b* that may be configured to receive a portion of the rotatable lever **66**.

The drain stopper **65** may include a cap **65***a* and a post **65***b* that extends from the bottom surface of the cap **65***a*. The cap **65***a* may be configured to cover the drain hole in the tub wall **7** (e.g., the floor, the bottom), the opening **68***a* in the housing **64**, or both when the drain stopper **65** is in the closed position. The drain stopper **65** may also include a sealing member or portion **71** that may be provided below the cap **65***a* to prohibit the escape of water through the drain valve assembly **13** when the drain stopper **65** is in the closed position. The sealing member **71** may be integrally formed with the drain stopper **65** or may be formed separately and coupled thereto, and may be made from any suitable material, such as from a resilient material. The post **65***b* of the drain stopper **65** may be configured as a circular shape or any suitable shape. The support **69***a* of the wall **69** of the housing **64** may include a bore to guide the post **65***b*, as the drain stopper **65** moves between the open and closed positions.

The rotatable lever **66** is configured to move the drain stopper **65** between the open and closed positions, when driven to movement, such as by the cable assembly **15**. The

rotatable lever **66** may include a shaft **66***a* (e.g., body) having a first (e.g., inner) arm **66***b* and a second (e.g., outer) arm **66***c* that extend from the shaft **66***a*. The shaft **66***a* may pass through the opening **69***b* of the wall **69** of the housing **64**, wherein the wall **69** may act as a bearing or guide for efficient rotation of the rotatable lever **66** relative to the housing **64**. The first arm **66***b* may be configured to reside in the cavity **70** of the housing **64** and have a distal end that is configured to contact the drain stopper **65** to move the drain stopper **65** between open and closed positions that correspond to movement of the rotatable lever **66**. The second arm **66***c* may be configured to reside outside of the wall **69** of the housing **64** (e.g., outside the cavity **70**), in order to be coupled to another device that is configured to move the second arm **66***c* to thereby rotate the rotatable lever **66** to move the drain stopper **65** between the open and closed positions. The second arm **66***c* may include a distal end having an opening that receives a lever, wherein the lever may move the second arm **66***c* between an open position, as shown in FIGS. **16** and **16**A, and a closed position, as shown in FIGS. **17** and **17**A. For example, the second arm **66***c* may be coupled to an overload device, such as discussed herein.

The drain valve assembly **13** may further include a seal or gasket **73** to prohibit the leaking of water. As shown, the gasket **73** may be provided between the base **68** of the housing **64** and the wall **7** of the bathing tub to prohibit the leaking of water therebetween. However, the gasket may be provided at any suitable location. Additionally, the drain valve assembly **13** may include a plurality of gaskets.

The drain valve assembly **13** may also include a biasing member **74** to provide a force to bias the rotatable lever **66**. The biasing member **74** may bias the rotatable lever **66** in the direction of closing or in the direction of opening. The biasing member **74** may be configured as a spring (e.g., coil spring, clock spring, extension spring, helical spring, etc.) or may have any suitable configuration that imparts a biasing force into the rotatable lever **66**.

An escutcheon (e.g., faceplate) may be coupled to the drain valve assembly **13** to provide improved aesthetics to the drain system **10**, whereby the aesthetics may be tailored to accommodate customer preference by switching out escutcheons. The escutcheon is discussed in greater detail below.

FIGS. **18**A and **18**B illustrate an exemplary embodiment of an overload device **76** (e.g., overload assembly). As shown, the overload device **76** may be provided between the cable assembly **15** and the drain valve assembly **13** to manage overloading in the cable, such as when a person steps on the drain stopper **65** when the drain stopper **65** is configured in the open position. The overload device **76** may include a linking member **77**, a sleeve **78**, and an energy absorber **79**. The linking member **77** may be coupled to the rotatable lever **66**, whereby movement of the linking member **77** may drive movement (e.g., rotation) of the rotatable lever **66**. The sleeve **78** may be configured to house the energy absorber **79**, a portion of the linking member **77**, and a portion of the cable assembly **15** to act as a guide to maintain alignment of the portion of the cable assembly **15** and the linking member **77**, as well as the energy absorber **79**.

The linking member **77** may include a first end **81** and a second end **82**. The second end **82** may be coupled to the rotatable lever **66**, whereby movement of the linking member **77** drives movement of the lever **66**. For example, the second end **82** of the linking member **77** may be pivotally coupled to the second arm **66***c* of the rotatable lever **66**, whereby substantially linear movement of the linking member **77** drives rotation of the lever **66** about the shaft **66***a*. As shown in FIG. **18**A, the first end **81** may be coupled to the sleeve **78**, such as through a threaded engagement, whereby the linking member **77** and the sleeve **78** may operate (e.g., move) together. For example, the outer surface of the first end **81** may include external threads that engage internal threads on the inner surface of the sleeve **78**.

The sleeve **78** may be configured as a hollow cylindrical member having a bore **84**. The bore **84** may pass through the entire length of the sleeve **78** and may be configured to receive the energy absorber **79**, a portion of the linking member **77**, and/or a portion of the cable assembly **15**. For example, the bore **84** may have internal threads that are engaged by external threads on the first end **81** of the linking member **77**. As shown in FIG. **18**A, the cable assembly **15** may include a plunger **93** that is coupled to the driven end **92** of the cable **90**, such that movement of the cable **90** moves the plunger **93** in the corresponding direction a corresponding length. The bore **84** (e.g., the end of the bore **84** that is opposite the end coupled to the linking member **77**) may receive the plunger **93**, wherein the plunger **93** may move within the bore **84** relative to the sleeve **78**.

The energy absorber **79** may be provided in the bore **84** between the plunger **93** and the first end **81** of the linking member **77**, wherein the energy absorber **79** is configured to manage (e.g., absorb) a load or force transferred through the overload device **76**. As shown in FIG. **18**A, the energy absorber **79** may be a spring, such as an extension spring or coil spring, that absorbs force by compressing and storing energy therein. As shown in FIG. **18**B, the outer end of the plunger **93** may be configured with a bore to receive one end of the energy absorber **79**, while the first end **81** of the linking member **77** may include an opposing bore to receive the other end of the energy absorber **79**. This configuration helps maintain the alignment between the plunger **93**, the energy absorber **79**, and the linking member **77**, while efficiently transferring loads to the energy absorber **79**. Thus, motion can be efficiently transferred through the energy absorber **79** and the overload device **76**, such as to drive the opening or closing of the drain valve assembly **13**, while absorbing loads in an overload condition.

During an overload condition, the energy absorber **79** may be configured to absorb any load or force greater than a threshold load (e.g., 30 lbs) that is imparted onto the drain stopper **65** and transfer only the threshold load (e.g., 30 lbs) to the cable assembly. The drain valve assembly **13** may be configured such that any additional load imparted into the drain stopper **65** beyond the threshold load causes the drain stopper **65** to contact the wall **7** of the bathroom fixture (or any suitable structural member) to thereby transfer the additional loads directly into the fixture. For example, if 300 lbs are imparted onto the drain stopper **65** when in the open position, the energy absorber only transfers the threshold load (e.g., 30 lbs of the 300 lbs), while the remaining load (e.g., 270 lbs) are transferred directly into the bathtub from the drain stopper **65**. It should be noted that the threshold load (e.g., the force) that is managed through the overload device **76** may be varied, as well as any maximum load that the drain system may be configured to withstand, and that the weights and loads disclosed herein are examples and are not limiting. Additionally, the overload device **76** may be configured to include devices other than (or in addition to) springs, such as dampers or dashpots, which may help absorb or dissipate energy.

The drain system (e.g., the cable assemblies) may include an overload device **76** to prevent damage to the drain system (e.g., the cable assembly), such as in the event a person steps on a drain stopper in the open position. For example, if a person steps on the drain stopper **65** when configured in the open position, such as shown in FIG. **16**, the weight of the

person may move the drain stopper **65** toward the closed position, as shown in FIG. **17**. The force imparted from the mass of the person to the drain stopper **65** is transferred from the drain stopper **65** to the rotatable lever **66** of the drain valve assembly **13**, which in turn transfers the force to the linking member **77** of the overload device **76**, causing the linking member **77** to move with the lever **66** relative to the plunger **93** of the cable assembly **15**. The overload device **76** (e.g., the energy absorber **79**) is configured to absorb a predetermined amount of force or load (e.g., a threshold force) to prohibit the full force of the weight of the person from being transferred directly to the cable assembly **15** and the control assembly **11**, because the cable assembly **15** and the control assembly **11** are still configured in the open position. By reducing the overload forces that are transferred to the control assembly **11** through the cable assembly **15** from the drain valve assembly **13**, the overload device **76** reduces the chance of damage to the drain system **10** (e.g., the control assembly **11**, the drain valve assembly **13**, the cable assembly **15**).

The overload device **76** also allows for the use of lower strength and lower mass materials, such as polymers and plastics, for components of the drain system that have traditionally been made from stronger and higher mass materials. The overload device **76** absorbs energy to reduce the force that is transferred or communicated through the cable. By transferring less force through the system, the components that are in the load path, such as the sliding member **40** and actuator **22** of the control assembly **11** as well as the drain stopper **65** and rotatable lever **66** of the drain valve assembly **13**, see less force and, therefore, may be configured to manage the reduced load by having a reduction in mass.

For example, without the overload device **76** and the energy absorber **79** therein, the force transferred to the linking member may be directly transferred to the end of the cable without any reduction in energy. This may result in damage to the control assembly (e.g., the actuator), the cable assembly, and/or to the drain valve assembly (e.g., the drain stopper).

According to another embodiment, the plunger that is coupled to the cable may also be coupled to the sleeve, such that the sleeve and plunger move together as one, while the linking member may move relative to the sleeve. For example, the plunger may include external threads to engage internal threads in the sleeve, while the linking member may have a smooth outer surface that slides along the inner surface of the bore of the sleeve.

The cable assembly **15** may include a cable **90** that may be provided within a conduit **16** (e.g., sheath, casing, etc.) to reduce the friction to improve efficiency of the cable **90**. The cable assembly **15** may be routed outside of the drainpipes (e.g., drainpipe **17***b*) of the drain system **10**, such as shown in FIG. **1**, where the cable assembly **15** may communicate (e.g., motion) from the control assembly **11** to the drain valve assembly **13**. Alternatively, the cable assembly may be configured to be routed inside one or more of the drainpipes of the drain system to communicate motion.

The cable **90** may include a wire that may be wound like a spring to have a spring like function, or may be configured using any suitable manner to communicate motion. The cable **90** having a wound wire configuration allows for the cable to turn at sharp or abrupt angles (e.g., 90 degrees) over relative short distances (e.g., small radii), while retaining a relative high efficiency. Accordingly, the cable may be routed out the back of the rear portion **27** of the housing **20** in a generally straight direction, as shown in FIG. **5**A, or may be routed out the back of the rear portion **27** and turn at any angle, such as turn at ninety degrees to route in a downwardly direction adjacent to the drainpipe **17***a*.

The cable **90** may include a driving end **91** and a driven end **92**, whereby the cable **90** is configured to transfer motion from the driving end **91** to the driven end **92** to communicate the input manipulation by a person (e.g., user) from the control assembly **11** to the drain valve assembly **13**. As shown in FIG. **5**A, the driving end **91** may be coupled to the control assembly **11**, such as to the sliding member **40** of the control assembly **11**. Accordingly, manipulation of the actuator **22** between the open and closed positions, may move the sliding member **40** thereby moving the driving end **91** of the cable **90** between corresponding open and closed positions. As shown in FIG. **18**A, the driven end **92** of the cable **90** may be coupled to the plunger **93**, whereby movement of the driven end **92** results in a corresponding movement of the plunger **93**.

The cable assembly **15** may further include one or more fittings **94**. The fittings **94** may be configured to retain the cable assembly **15** by fixing a portion thereof to another component. For example, the fittings **94** may be coupled to the conduit **16** of the cable assembly **15**, such that the ends **91**, **92** may move relative to the fittings **94** and/or the conduit. Each fitting **94** may also be configured to attach (e.g., couple) to a fixed member, such as the housing of the drain valve assembly.

The cable assemblies disclosed herein, such as cable assembly **15**, may be used in conjunction with either actuator **22** of the control assembly **11** to control the opening and the closing of the drain valve assembly **13**. For example, the cable assembly **15** that is configured to be routed out the back of the rear portion **27** of the housing **20** of the control assembly **11** may be moved by a rotary actuator, such as actuator **222**. Accordingly, the user may input a rotational manipulation to thereby rotate the actuator **222** to move (e.g., pull, push) the cable to open and close the drain stopper **65** of the drain valve assembly **13**. Alternatively, the user may install the linear actuator **122**, whereby the user may input a linear manipulation to thereby move the cable to open and close the drain stopper **65** of the drain valve assembly **13**.

FIGS. **19-20** illustrate an exemplary embodiment of a mounting plate **95** that is configured to be coupled to the control assembly **11** (e.g., the mounting base **25** of the housing **20**) to provide for mounting of an escutcheon **97** thereto. The mounting plate **95** may mount to the external surface of the wall **7** of the bathroom device or fixture, and may be coupled to the control assembly **11** through any suitable method, such as conventional fasteners (e.g., screw, bolt). The mounting plate **95** may be annular shaped to engage an annular hole in the wall **7** of the fixture, wherein the annular shaped mounting plate **95** may include an opening **95***a* to allow the actuator **22** to pass therethrough, such as to permit the actuator **22** to engage the housing **20** and/or the switching mechanism **21**. The mounting plate **95** may further include one or more than one tab **95***b*, which may provide for selective coupling of the escutcheon **97**. For example, the mounting plate **95** may include a plurality of tabs **95***b* that are circumferentially configured around the mounting plate **95** at various angular travels or distances.

A mounting plate **195** may be configured to be coupled to the drain valve assembly **13** to provide for mounting of an escutcheon thereto. The mounting plate **195** may mount to the external surface of a wall (e.g., lower wall) of the bathroom device using any suitable method, and the mounting plate **195** may include one or more tabs to allow for coupling of an escutcheon thereto. The mounting plate **95** for the control assembly **11** and the mounting plate **195** for the drain valve assembly **13** may be similarly configured or may be configured differently. For example, the mounting plates **95**, **195** may include a similar number of tabs that are located at

common locations (e.g., diameter, angular distance, radial distance), whereby a common escutcheon (e.g., the escutcheon **97**) may be coupled to one or both of the mounting plate **95**, **195**. However, the mounting plates **95**, **195** may be configured to be dissimilar, such as by having different diameters or differently configured tabs (e.g., number, location).

Additionally, the drain valve systems and the control assemblies, as disclosed herein, may include aesthetic escutcheons that may be easily replaced by the customer without having to replace any of the hardware, such as the housings of the control assemblies and/or the drain valve assemblies or portions thereof below the wall of the bathroom fixture, to allow the user to tailor the aesthetics of the drain valve systems, such as to match other fixtures in the bathroom, without the cost and difficulty of replacing the hardware of the systems. In effect, the customer may give the fixture a "face-lift" at minimal expense and labor, simply by replacing the escutcheon.

FIGS. **21**A-**21**D illustrate exemplary embodiments of escutcheons **97**, **197**, **297**, **397**. The escutcheons **97**, **197**, **297**, **397** are configured to be able to be selectively coupled to the mounting plates **95**, **195**, such as, for example, by snapping over the tabs of the mounting plates. The escutcheons **97**, **197**, **297**, **397** may include a feature, such as a pocket or hook on the backside to receive the mounting tab of the mounting plate. The escutcheon and/or the mounting plate may be configured to be flexible in order to allow flexing when the escutcheon is coupled to the mounting plate. Accordingly, the escutcheon may be secured or coupled to the mounting plate using an interference fit, and the escutcheon and mounting plate can accommodate a relative greater variation (e.g., tolerance) of the wall of the bathroom fixture. The escutcheon (e.g., outer surface) may be configured having a decorative design and/or may be made from a material (e.g., brass, stainless steel) to improve the aesthetics of the drain system.

The configuration of the escutcheon and the mounting plate allows for the customer to thereby tailor the aesthetics of the drain system simply by replacing the current escutcheon with another escutcheon having a preferred appearance. For example, the customer may remove the escutcheon **97** and install in its place the escutcheon **197** to thereby tailor the aesthetics of the drain system without replacing any hardware, such as the rough-in assembly or the mounting plate.

As utilized herein, the terms "approximately," "about," "substantially", and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numerical ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and claimed are considered to be within the scope of the invention as recited in the appended claims.

It should be noted that the term "exemplary" as used herein to describe various embodiments is intended to indicate that such embodiments are possible examples, representations, and/or illustrations of possible embodiments (and such term is not intended to connote that such embodiments are necessarily extraordinary or superlative examples).

The terms "coupled," "connected," and the like as used herein mean the joining of two members directly or indirectly to one another. Such joining may be stationary (e.g., permanent) or moveable (e.g., removable or releasable). Such joining may be achieved with the two members or the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional intermediate members being attached to one another.

References herein to the positions of elements (e.g., "top," "bottom," "above," "below," etc.) are merely used to describe the orientation of various elements in the FIGURES. It should be noted that the orientation of various elements may differ according to other exemplary embodiments, and that such variations are intended to be encompassed by the present disclosure.

It is important to note that the construction and arrangement of the drain systems as shown in the various exemplary embodiments is illustrative only. Although only a few embodiments have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter described herein. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes and omissions may also be made in the design, operating conditions and arrangement of the various exemplary embodiments without departing from the scope of the present invention.

What is claimed is:

1. A cable overload device for a cable-actuated drain system that includes a drain valve assembly and a drain control assembly where the cable includes a driving end connected to the control assembly and a driven end, the overload device comprising:

a plunger configured to be coupled to the driven end of the cable;

a linking member configured to move the drain valve assembly between open and closed positions;

a sleeve having a bore that extends from a first side to a second side of the sleeve, wherein the bore is configured to receive the plunger through the first side and to receive the linking member through the second side; and

an energy absorber provided in the bore between the plunger and the linking member to absorb a force imposed into the linking member from the drain valve assembly;

wherein the linking member is coupled to the sleeve to prevent relative motion between the linking member and the sleeve.

2. The overload device of claim **1**, wherein the linking member includes a first end that is coupled to the sleeve to prevent relative motion between the linking member and the sleeve.

3. The overload device of claim **2**, wherein the linking member further includes a second end that is configured to move the drain valve assembly between open and closed positions.

4. The overload device of claim **3**, wherein a rotatable lever is driven to rotate by movement of the linking member, which in turn moves a drain valve assembly between the open and closed positions.

5. The overload device of claim 2, wherein the plunger is free to move in the bore relative to the sleeve when driven by movement of the cable.

6. A cable overload device for a cable-actuated drain system that includes a drain valve assembly and a drain control assembly where the cable includes a driving end connected to the control assembly and a driven end, the overload device comprising:

a plunger configured to be coupled to the driven end of the cable;

a linking member configured to move the drain valve assembly between open and closed positions;

a sleeve having a bore that extends from a first side to a second side of the sleeve, wherein the bore is configured to receive the plunger through the first side and to receive the linking member through the second side; and

an energy absorber provided in the bore between the plunger and the linking member to absorb a force imposed into the linking member from the drain valve assembly;

wherein the plunger is coupled to the sleeve to prevent relative motion between the plunger and the sleeve.

7. The overload device of claim 6, wherein movement of the cable moves the coupled plunger and sleeve.

8. The overload device of claim 6, wherein the linking member is free to move in the bore relative to the sleeve.

9. The overload device of claim 2, wherein an outer surface of the first end of the linking member is coupled through threads to an inner surface of the bore of the sleeve.

10. The overload device of claim 1, wherein the linking member is integrally formed with the sleeve to prevent relative motion between the linking member and the sleeve.

11. A drain valve system for a fixture, comprising:

a housing configured to mount to a wall of the fixture and having an opening;

a drain stopper configured to move within the opening between an open position and a closed position;

a lever pivotally coupled to the housing and including a first arm and a second arm, the first arm being configured to move the drain stopper upon rotation of the lever;

a cable having a driven end and a driving end that is connected to a drain control assembly configured to move the cable; and

a cable overload device comprising:

a plunger coupled to the driven end of the cable;

a linking member having a first end and a second end coupled to the second arm of the lever, such that movement of the linking member rotates the lever;

a sleeve having a first side that receives the driven end and a second side that receives the linking member; and

an energy absorber disposed between the plunger and the linking member to absorb a force imposed into the linking member from the drain stopper;

wherein the sleeve is configured to move with one of the plunger and the linking member relative to the other of the plunger and the linking member.

12. The drain valve system of claim 11, wherein the sleeve includes a bore that extends from the first side to the second side of the sleeve.

13. The drain valve system of claim 12, wherein the energy absorber is provided in the bore of the sleeve.

14. The drain valve system of claim 11, wherein the first end of the linking member is coupled to the sleeve to prevent relative motion between the linking member and the sleeve.

15. The drain valve system of claim 14, wherein the plunger is free to move relative to the sleeve when driven by movement of the cable.

16. The drain valve system of claim 12, wherein the plunger is free to move in the bore relative to the sleeve when driven by movement of the cable.

17. The drain valve system of claim 11, wherein the plunger is coupled to the sleeve to prevent relative motion between the plunger and the sleeve.

18. The drain valve system of claim 17, wherein movement of the cable moves the coupled plunger and sleeve, and wherein the linking member is free to move relative to the sleeve.

19. The drain valve system of claim 14, wherein the first end of the linking member is coupled through threads to the sleeve.

20. A cable overload device for a cable-actuated drain system that includes a drain stopper and a control assembly, the overload device comprising:

a cable having a driven end and a driving end connected to the control assembly;

a linking member configured to move the drain stopper between an open position and a closed position;

a sleeve having a first side that receives the driven end and a second side that receives the linking member; and

an energy absorber provided between the driven end and the linking member to absorb a force imposed into the linking member from the drain stopper;

wherein the linking member is coupled to the sleeve to prevent relative motion between the linking member and the sleeve.

21. The overload device of claim 20, wherein the driven end includes a plunger, and wherein the first side of the sleeve receives the plunger.

22. The overload device of claim 20, wherein the sleeve includes a bore that extends from the first side to the second side, and wherein the bore receives the driven end through the first side and receives the linking member through the second side.

23. The overload device of claim 20, wherein the linking member includes a first end that is coupled to the sleeve to prevent relative motion between the linking member and the sleeve.

24. The overload device of claim 23, wherein the driven end is free to move relative to the sleeve when driven by movement of the cable.

25. A cable overload device for a cable-actuated drain system that includes a drain stopper and a control assembly, the overload device comprising:

a cable having a driven end and a driving end connected to the control assembly;

a linking member configured to move the drain stopper between an open position and a closed position;

a sleeve having a first side that receives the driven end and a second side that receives the linking member; and

an energy absorber provided between the driven end and the linking member to absorb a force imposed into the linking member from the drain stopper;

wherein the driven end is coupled to the sleeve to prevent relative motion between the driven end and the sleeve, and wherein movement of the cable moves the coupled driven end and sleeve.

26. The overload device of claim 25, wherein the linking member is free to move relative to the sleeve.

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